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ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY.

Vol. 28. 505 PEARL STREET, NEW YORK. No. 31.

Index to Advertisers and Classified Index Following Reading Matter.

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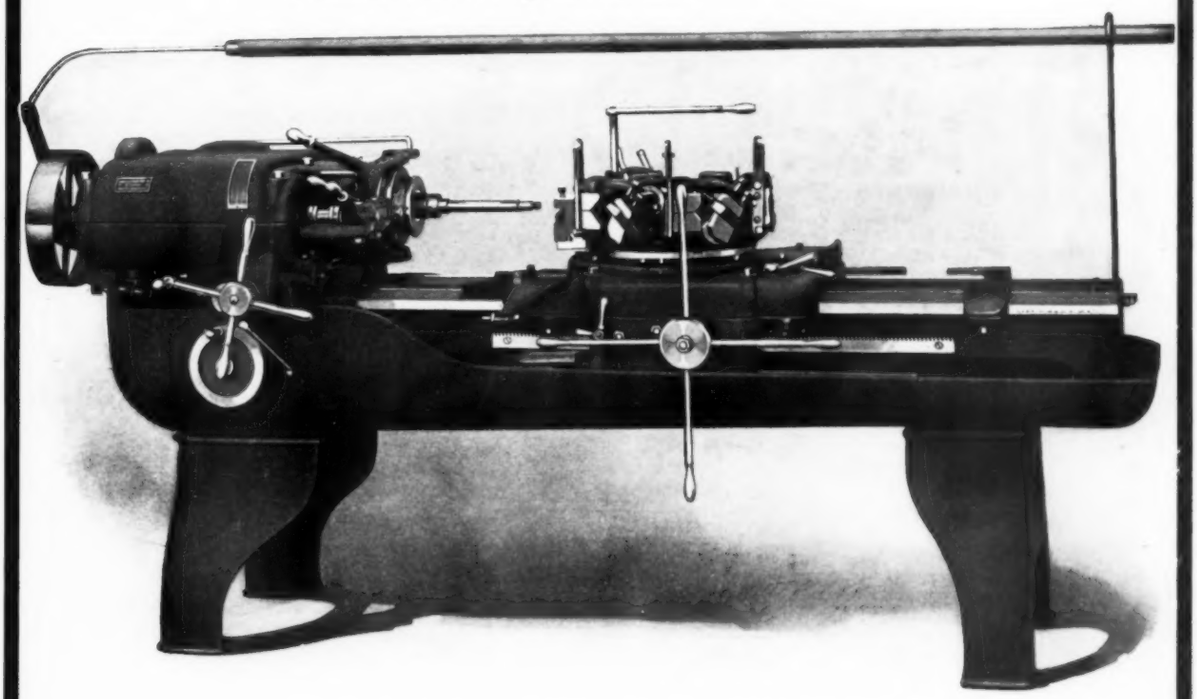

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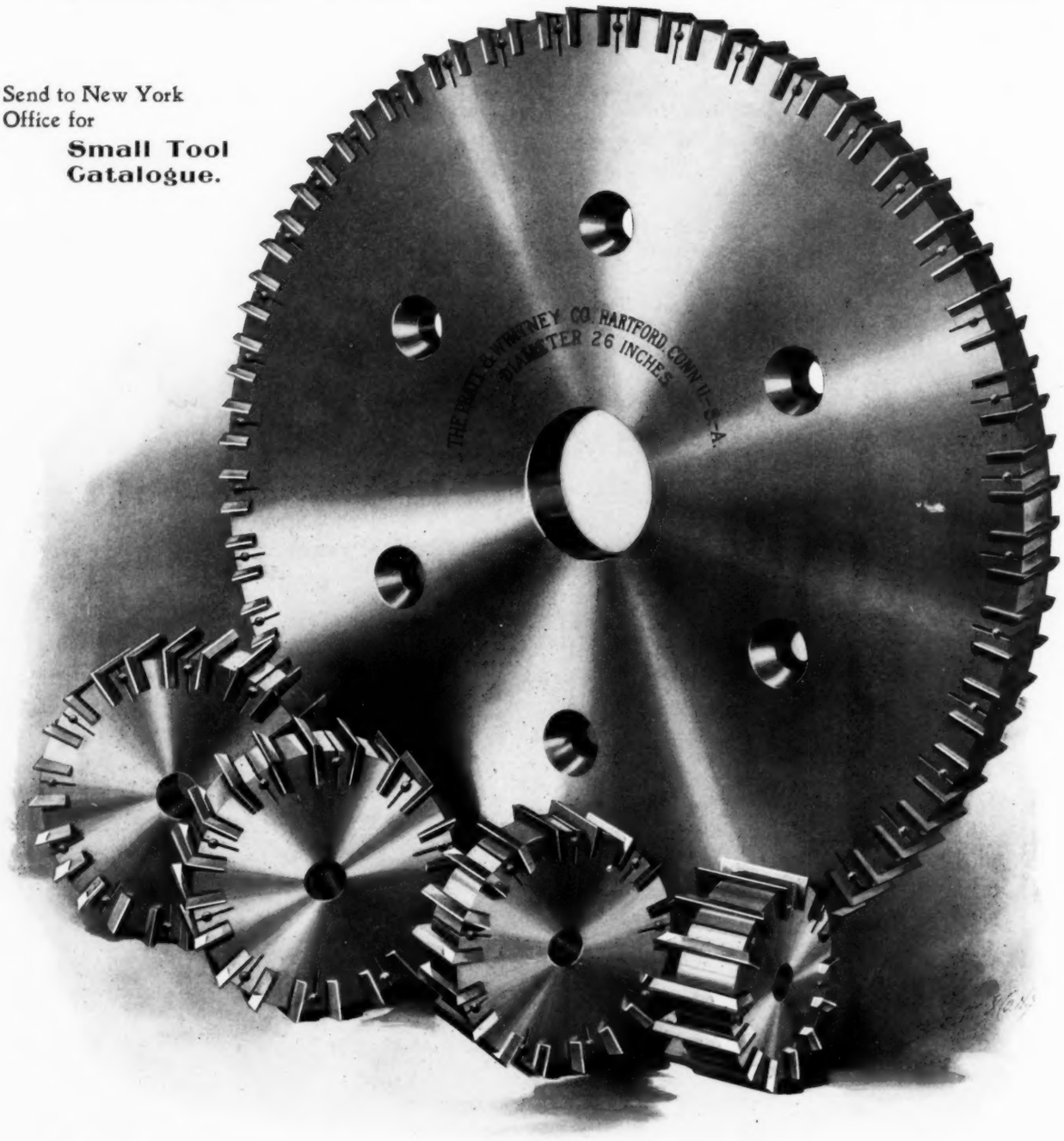

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An English Gear-Cutting Works.

BY I. W. CHUBB.

David Brown & Sons (Hfd.) Ltd., Huddersfield, England, are reputedly the largest firm in Europe devoted solely to gear cutting, their average output being about 12 tons of wheels, cutting only, a week. Their works are situated at Lockwood, near Huddersfield, conveniently close to a railway station. They are in an elevated, healthy position, as illustrated in the outside views, Figs. 1 and 2, and their general arrangement is shown in the plan, Fig. 3. Special apartments for the employees are located under the offices, and have every convenience for the workmen's comfort, such as well-equipped dining and reading rooms, views in which are given in Figs. 4 and 5. In the stores, in the middle of the workshop, is a medicine chest for dealing with slight accidents. Each man has a clothes closet, together with key, so that if necessary he can make an entire change when leaving the works. This is a feature generally absent from British shops. Washing accommodation is provided, the men supplying their own soap and towels, while the lavatories and mess rooms are self-supporting, the men being charged a penny a week, plus the cost of the meals. The firm provides the crockery, ovens for warming and cooking, fittings, etc. This department is run by a committee of the men. The Rochester time clock is used, the men being checked, not in the offices, but inside the works, as close as possible to their respective departments. The business is confined entirely to the manufacture and cutting of gear wheels, the number of men and boys employed averaging 170, exclusive of the drawing and commercial office staff. One man attends to two or three machines, according to the size and class of work, and payment is by time.

FIG. 1. GENERAL VIEW OF GEAR-CUTTING WORKS.

SHOP CONSTRUCTION AND ARRANGEMENT OF DEPARTMENTS.

The building is so made that it can easily be extended at any time in any direction. The ends, for instance, are both alike, being double-boarded and having steel beams carried across to take the wind pressure. The stanchions, etc., are already drilled and levels of floors, etc., are taken for extensions. Then, the outside work being done, the existing partitions would simply be removed, the extension implying no admission of dust to the existing shops. The brickwork of the sides would come away much like the ends.

The main shop is heated by live steam and is divided into departments, all of which are lofty, so that, as a rule, long belt drives are obtained. Each department is concerned with a separate process. For instance, one bay is devoted to turn-

FIG. 2. FRONT VIEW OF BUILDING.

ing heavy blanks, and the next bay is for the lighter turning and the manufacture of rawhide pinions, the plan giving a key to the scheme. The arrangement is such that the job makes as short a circuit as possible, passing as directly as convenient from entry to turning, tooth cutting, test and delivery. All jobs are examined after being turned and bored and then after being cut. Blanks sent in ready turned are checked before they are cut, and, if necessary, corrected. A machine is under design to test all gears by power. At present this is done by hand.

For the tool room and grinding department, one complete bay is provided, and adjoining it is the hardening and annealing room. On the opposite side of the shop are bays devoted to cutting the teeth of bevel, spur, spiral and worm gear, racks, etc. It may thus be said that one-half of the shop is set apart for the cutting of teeth and the other half to the preparatory work. The plan shows the position of the rough steel stores and of the smith's shop for tool forging, etc., while diagonally opposite are the shops in which wheels are inspected, painted, oiled, etc. In each bay are 8-ton overhead traveling cranes, and all round the works is a small trolley track, this running through each department, and communicating with the testing and packing rooms for conveying the blanks and finished wheels. One foreman is allotted to each half bay, and every department has its own closets, etc., for the men, under the complete control of the foreman.

TURNING DEPARTMENTS.

The turning departments, Figs. 6 and 7, are complete with turning and boring mills, chucking machines, turret and high-speed lathes, etc. And here it may be mentioned that throughout the works machines from all over the globe are employed. All turning and boring mills, and, in fact, all the larger tools, are independently driven by electric motors. High-speed steel is used throughout, very good results having been obtained, particularly with milling and gear cutters. Gages are on the limit system.

For the rawhide gears (turned in the department at the left-hand side in Fig. 8), a special seasoning stores carries a stock amounting to more than 10 tons of rawhide. Thus the firm can turn out, at very short notice, rawhide pinions thoroughly seasoned. These pinions are, in fact, a speciality of the firm, and they have, in individual cases, been made to transmit 300 horse-power. Machines are employed solely for riveting up these pinions.

THE TOOLROOM.

In the toolroom, Fig. 9, is a complete cutter-making plant, consisting of relieving lathes, special forming lathes for turning the cutter blanks, universal and plain milling machines, together with cylindrical and plain grinding machines; while in the hardening and annealing room there are the necessary coke and gas furnaces and cooling baths for hardening. Each furnace will harden cutters up to 300 pounds in weight. Among the backing-off lathes is the largest machine of its kind in England, its capacity including cutters 18 inches diameter by 5 feet long, with lead of 70 inches. The Brown & Sharpe micrometer is used with all these machines. In the cutter department can be made gear cutters with machine-relieved teeth up to 6-inch circular pitch and multiple-threaded hobs for hobbing worm-wheels up to 6-inch single pitch, while multiple threads can be relieved up to 50-inch lead and 15-inch pitch diameter. All cutters are kept in boxes which hold a complete set.

The tool stores contain complete sets of gages and forming tools for the different tooth curves. Full sets of stocking or roughing out cutters are also kept, and these are from ¼ inch to 4½ inch circular and

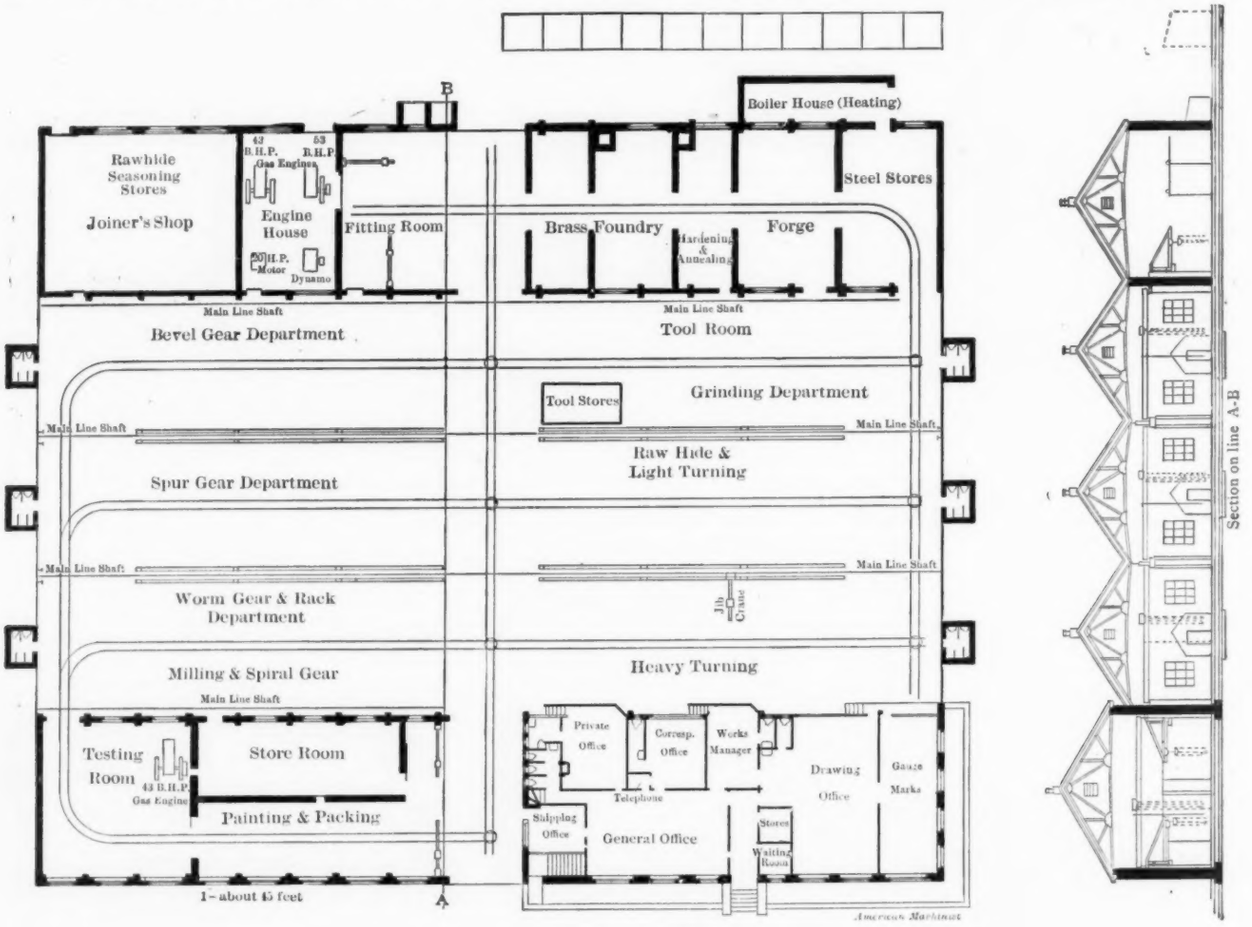


FIG. 3. PLAN OF WORKS.

FIG. 5. READING ROOM.

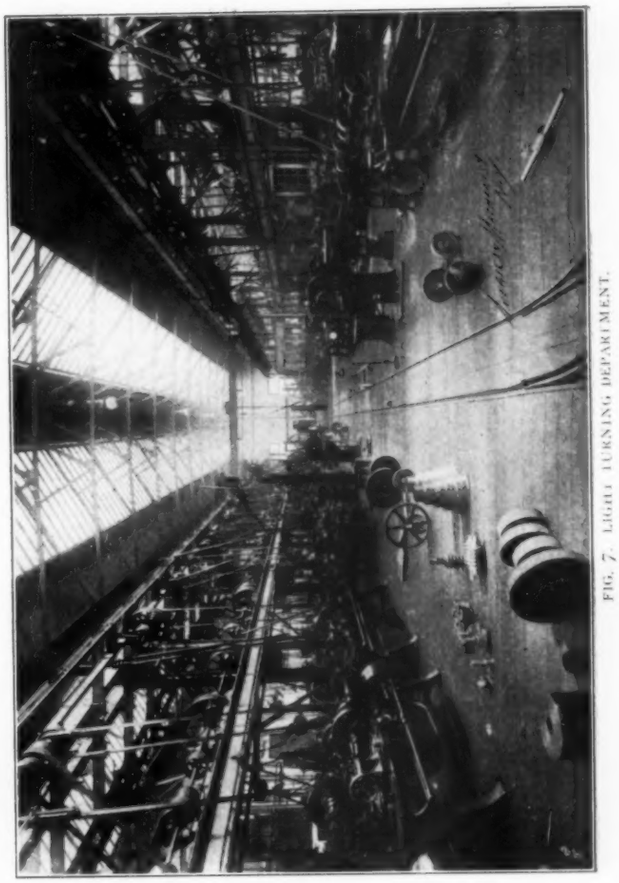


FIG. 7. LIGHT TURNING DEPARTMENT.

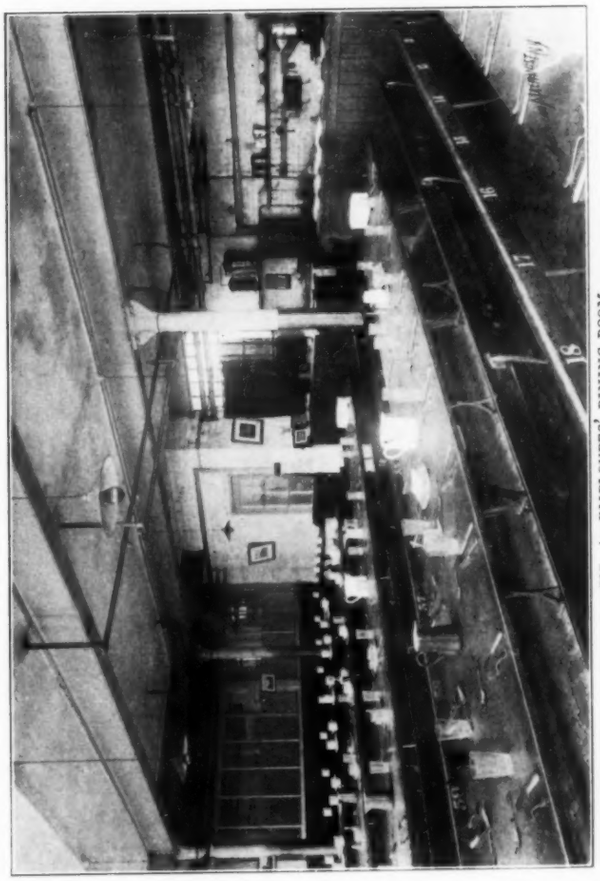


FIG. 4. EMPLOYEES' DINING ROOM.

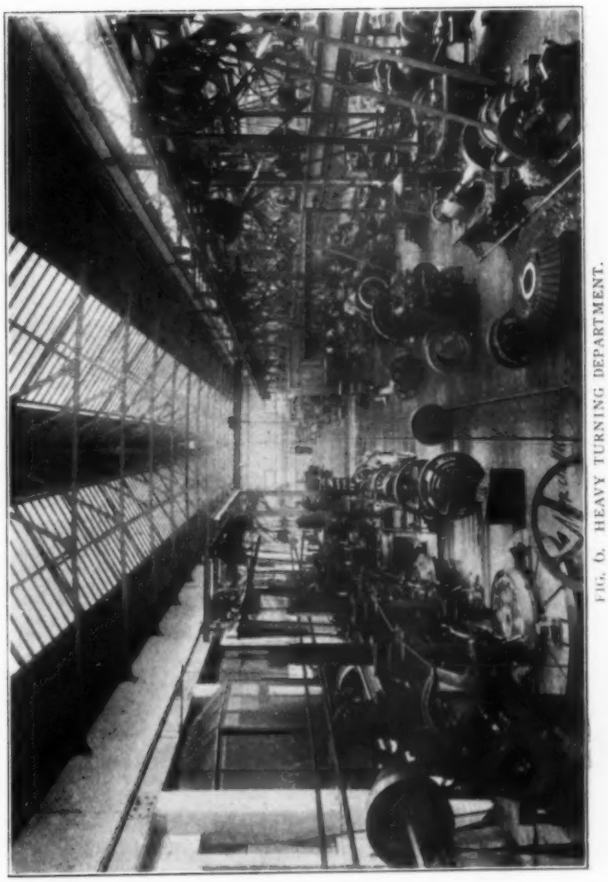


FIG. 6. HEAVY TURNING DEPARTMENT.

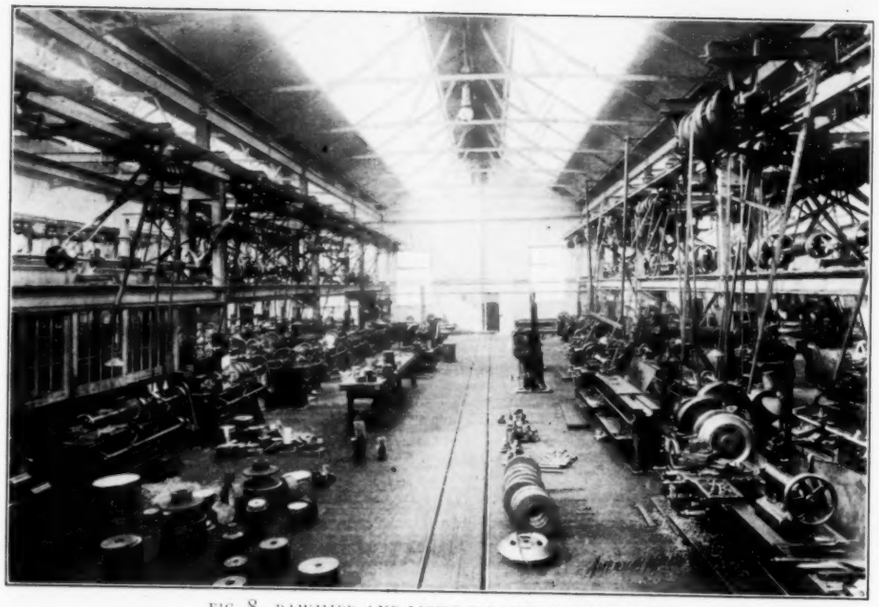


FIG. 8. RAWHIDE AND LIGHT TURNING DEPARTMENTS.

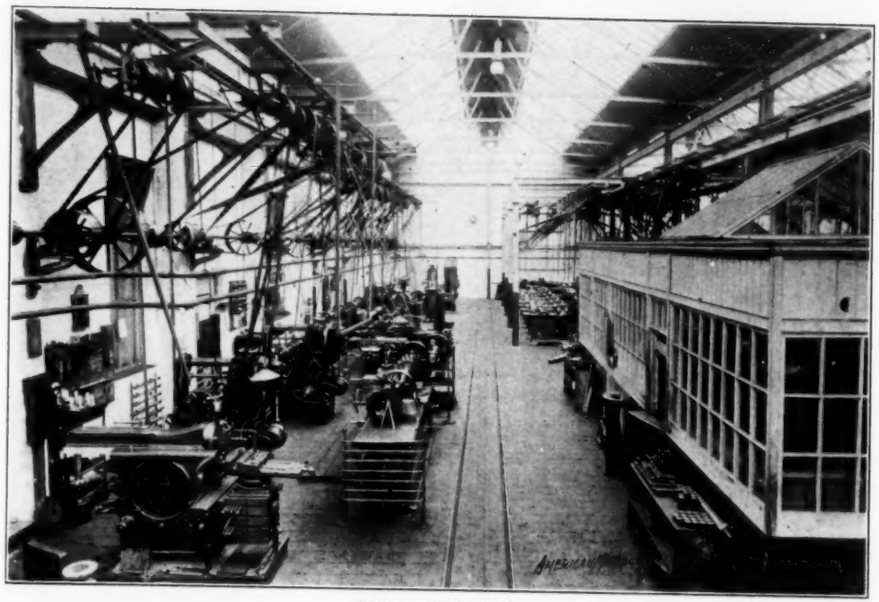


FIG. 9. TOOLROOM.

20 to ¾ inch diametral pitch. Flat gages and tools are kept together in lockers.

WORM-GEAR CUTTING.

About 700 hobs are in use for worm gears—cut in the department shown in Fig. 10—this being possibly the largest set of hobs in the world. The pitches vary from ¼-inch to 6-inch circular, and the pitch diameters from less than 1 inch to 16 inches. These hobs are made on the taper principle, containing roughing and finishing threads, and when the teeth are being cut the wheel and the hob are of course driven independently, the hob feeding along a line tangential to the wheel, bringing first the roughing and then the finishing teeth into action. A list of the hobs is published and sent to clients, so that they can arrange their work to suit and thus avoid the expense of making new hobs. The standard worm thread to which these hobs apply has a space on the pitch line equal to the thread thickness. The total hight of the thread is .686 of the pitch, the distance above the pitch line being .318 of the pitch. The thread has straight sides cut at an angle of 75°, the apex angle being consequently 30°. The corners are rounded slightly as usual. Worm-gear to transmit 500 horse-power is, so far, the limit in this department. Machinery for rapidly milling worms is installed, and in connection with this department is a complete plant for hardening worms and grinding the threads after they have been hardened. Thus worms can be finished up to 20 inches diameter and 6 feet long. Multiple threads are of course cut and in fact worms having 32 threads have been made by the firm. Globoid or Hindley worm gearing is not cut. In worm gearing generally every attempt is made to get high efficiency, this approaching 95 per cent. where the worm angle is very high, while 87 per cent. is guaranteed with 5-threaded gear, 2½-inch pitch, 12½ inches lead. To give an idea of the accuracy of the work, worm gear for motor cycles can be shown, which, after running 10,000 miles, still bear the tool marks. The limit for worm gear hobbing is 8 feet diameter by 6 inches pitch for single thread worms, or 50 inches for multiple thread worms.

Worm reducing gear (Fig. 11), is another speciality of the firm. In the wheel a special feature is a heavy phosphor-bronze rim. This necessarily increases the first cost. But in working with a light rim there is a great tendency to buckle and turn on the center, thus causing very great trouble owing to the heating which results. Double thrust ball bearings are used, with ample oil reservoir and oil level indicator, and long and heavy self-oiling and dust-proof phosphor-bronze bearings. The worms are of steel, cut solid in the shaft. Owing to the demand for these reduction gears the department for them had recently to be considerably enlarged. The limits of sizes at present made are ¼ horse-power and 250 horse-power, there being in all about 30 standard sizes.

SPUR AND BEVEL GEAR DEPARTMENTS.

In the spur-gear department, Fig. 12, the capacity is up to 12½ feet diameter and 4½-inch pitch. A set of fourteen cutters is used for each pitch to give as small steps in the series as practicable. Of course this means greater expense to the firm in cutters. At the time of the writer's visit, a 10-foot mortise wheel for pumping was being machined. Slotting generating machines have been found better for small gear, but milling cutters are used for larger work. The job is roughed out first and then finished with a very fine cut, the latter being regarded as very important. Internal gears can be cut up to 13 feet diameter.

The bevel-gear department, shown in Figs. 13 and 14, can at present plane wheels up to 4 feet diameter, but ma-

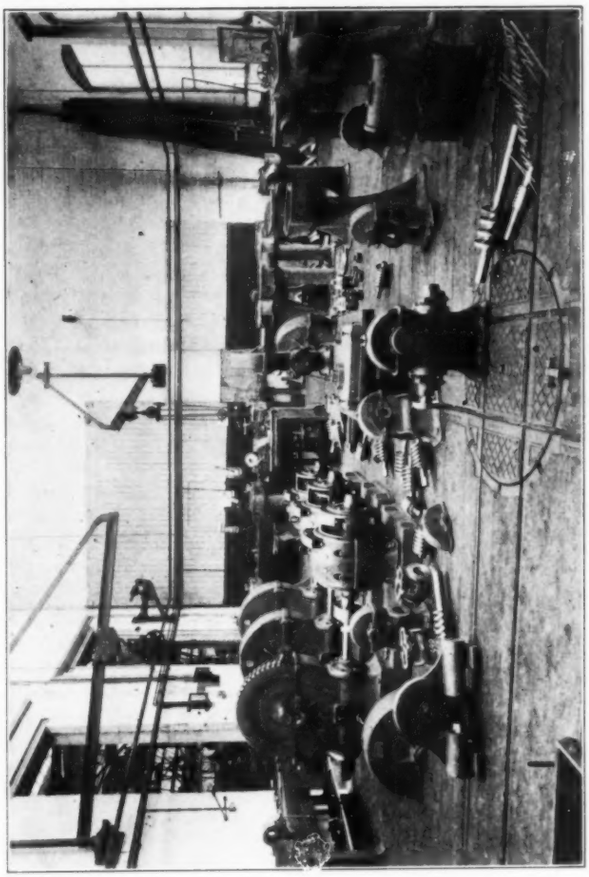


FIG. 11. WORM-REDUCTION GEAR.

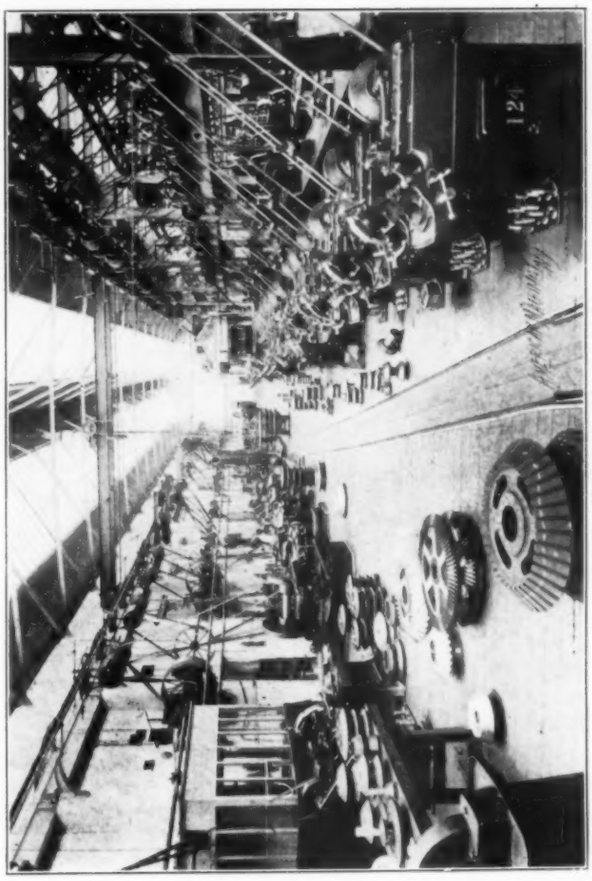


FIG. 13. BEVEL-GEAR DEPARTMENT.

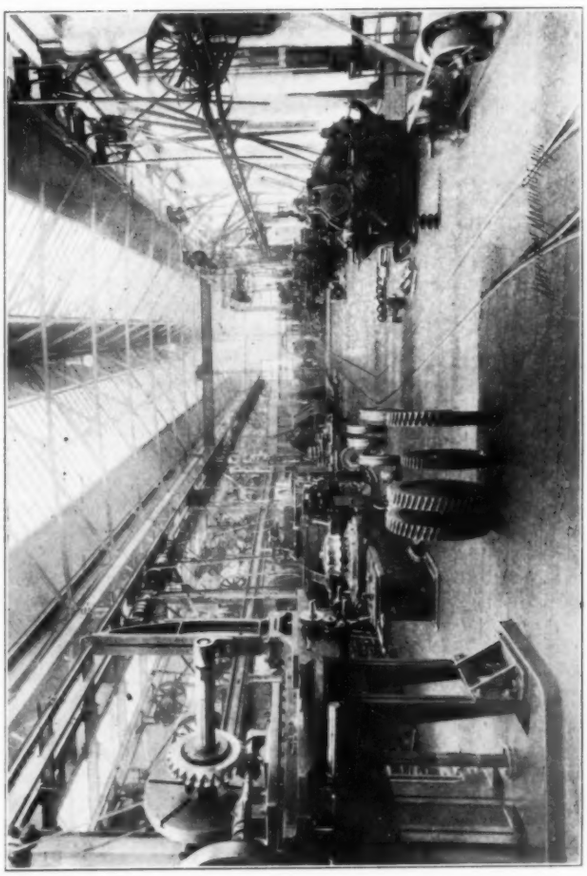


FIG. 10. WORM-GEAR DEPARTMENT.

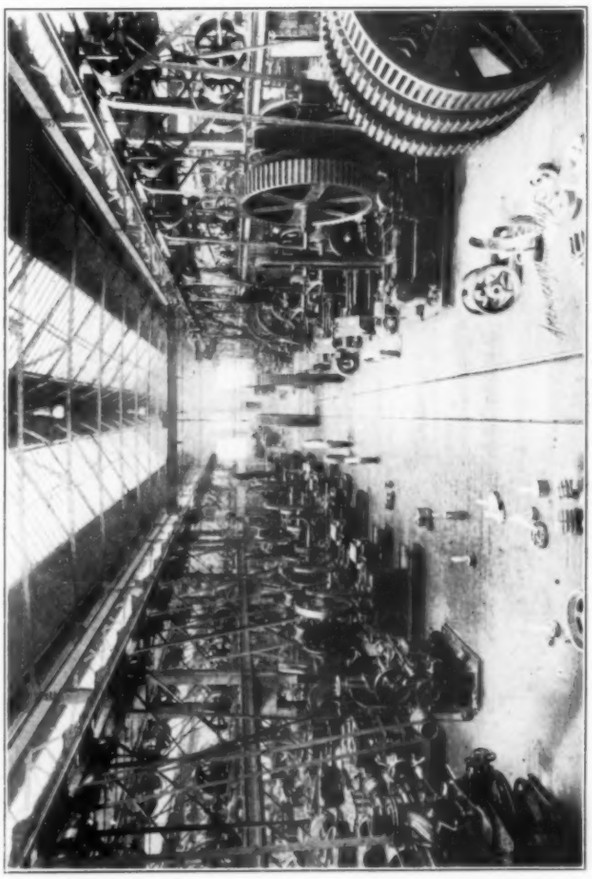


FIG. 12. SPUR-GEAR DEPARTMENT.

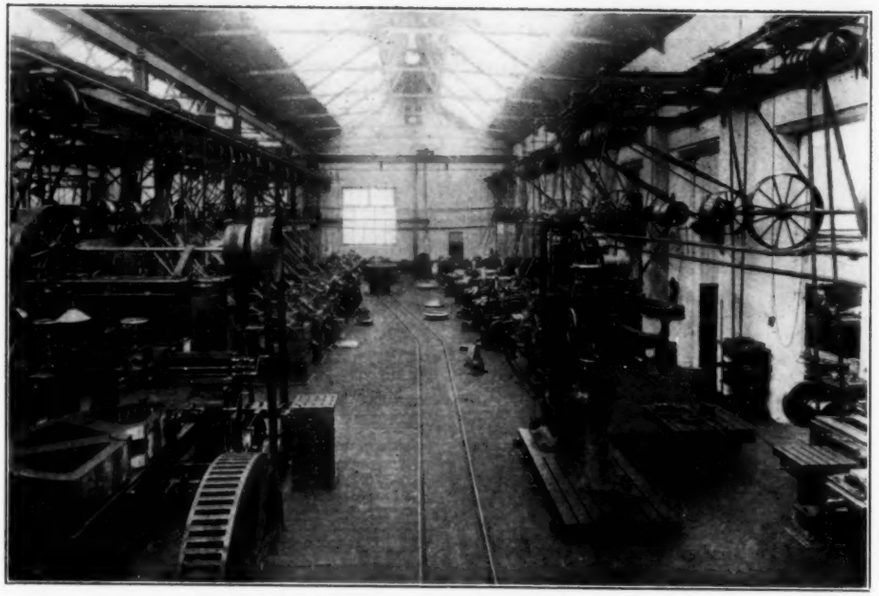


FIG. 14. BEVEL-GEAR DEPARTMENT.

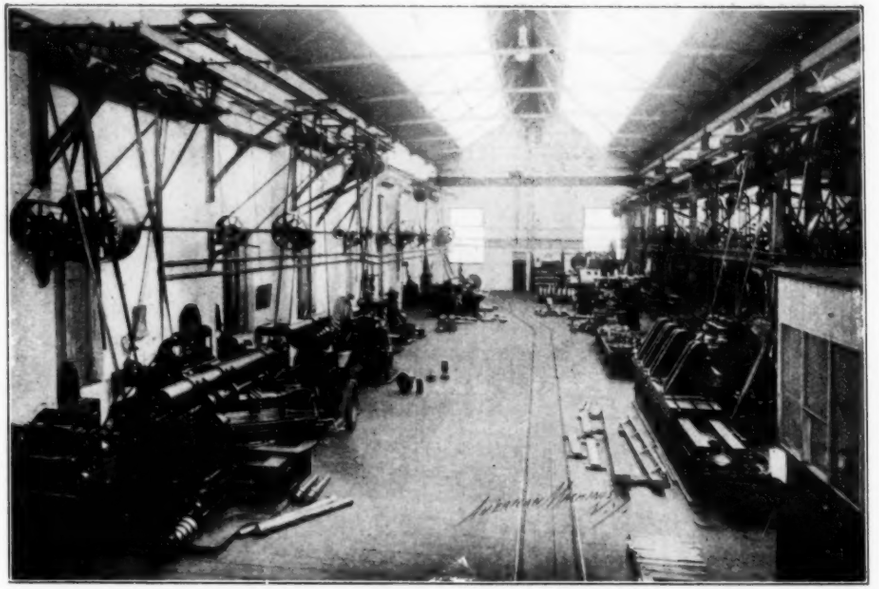


FIG. 15. SPIRAL-GEAR DEPARTMENT.

chines are ordered which will increase this capacity up to 8 feet diameter. The gears are planed to the correct cone lines on special machines, and for smaller wheels, up to 20 inches diameter special machines generate the true curves. The bevel planers installed form probably the largest plant of the kind in Europe, all makes being represented. Spiral gears are cut up to 5 feet diameter with any length of spiral, and racks to any length or pitch. A view in the department for cutting such work is shown in Fig. 15.

MATERIAL FOR GEARS.

A brass foundry is attached to the works, making only special phosphor-bronze and gun-metal castings, up to 2 tons. An alloy is also supplied which is especially suitable for machine-cut gears, and stoves for core drying, etc., are installed, but castings in iron and steel are obtained outside the works. All steel gears are made from a special toughened steel and gray-iron gears from a special mixture. In cast steel, if the pitches are suitable, the spaces are rough cast to ensure sound teeth. For steel pinions hammered forgings are used, no pinions being cut from the bar. Similarly for car work a special high tensile steel is used which has proved to be exceedingly tough and to caseharden with very good results.

Finally, each department is complete in itself, machines being used for one purpose only. For example, spur gears are cut on automatic spur-gear cutters, which will not do anything else; the same with bevel gears, which are planed on special bevel planers; and so on. The motive power consists of three gas engines, having a total of 139 horse-power. In addition 110 horse-power is used in electric motors which are at present run from the town's mains.

The Practical Value of Water-Powers, and the Future of Their Development.*

The perfect conditions for water-power development exist in but one locality which so far has been discovered, and those who are looking for ideal conditions can be referred only to the Niagara situation. The simplest conditions for power development are found along the northern border of the United States where the great lakes form immense storage reservoirs, and where the climatic conditions of Southern Canada co-operate with these Great Lakes and insure a practically constant flow of water at all seasons of the year. It surely requires but little foresight to judge that success will probably attend the development of a water-power at Niagara backed by those storage reservoirs; where the neighborhood of the city of Buffalo has already solved in part a portion of the market question and for the rest has proven the desirability of the locality for the homes of workmen; while the existence of both water and rail transport of the best leaves no question unsolved for the location of new industries.

Leaving Niagara, the problems begin to increase in difficulty. At the Soo, the water flow is constant and the transportation facilities are good, but the problem presented by the labor market is more difficult. Shawinigan, with its wonderful cheapness of hydraulic development, is comparatively at a disadvantage as regards the market for its power. Massena is shut in on all sides by the possibilities of almost similar developments in its neighborhood from the St. Lawrence river.

The problems presented by all these powers along our northern border, on ac-

*Portion of an address by Frederick A. C. Perrine at Purdue University.

count of the constancy of the water-flow, are relatively simple when compared with those presented to the investigator of water-powers in almost any other part of the country, if not by all others in the civilized world. Compare them for example with the powers along the Susquehanna, where a variation of flow of 200 per cent. must be encountered; where ice gorges totally stop the flow of the river for days and even weeks. Or, with the rivers of the South, such as the Savannah, where for a period of each summer, flow falls to not more than 10 per cent. of the average; where the users are almost solely textile factories accustomed to operations of not more than eleven hours a day, and where these industries themselves are a development of an almost new manufacturing region, whose past has not as yet sufficient history to allow safe prediction of the distant future. Or, with the powers of the Rocky Mountain region, where the laws recognize irrigation rights as superior to those of the power user and the customer is the miner with his traditional uncertainty. Or, with the water plants of the Pacific Coast whose distance from the center of population has occasioned the boldest feats of electrical engineering, harnessing voltages which but a few years ago were considered comparable with lightning; and in which every detail of the plant, either hydraulic, mechanical or electrical, has called for new solutions almost of a revolutionary character. And yet each of these regions has its successful plants, not one but many, not struggling undertakings but commanding successes.

When we consider these facts we cannot fail to perceive that the criteria of success presented by these situations may not be generally applied, and it is necessary for us to establish more general criteria of success before we make our examinations and trust our judgment either to condemn or accept the opportunities presented for new developments.

First and foremost in the investigation we need to judge the flow of the water, its maximum, minimum and its average. Water is one of the commonest of the elements; it is always raining somewhere and at times it rains everywhere. The rivers always flow, but it is not safe to conclude that we necessarily have a successful power development if there be only a dam site and a stream.

Actually no one who has ever had occasion to examine water sheds can realize their variability as compared with each other and as each one is compared at different times, and in a majority of the cases where water investigations are undertaken a careful estimate will reduce the water available below that which those who have lived along its banks estimate to be its minimum capacity. And yet minimum capacity is valuable only as a term in the comparison; often regarded as the all important term, and combined with the statistics of the steam power in use, as the criterion of usefulness.

In determining the minimum flow of a river, and basing upon that our estimate of its worth, we are shutting our eyes to every fact the electrical utilization of power has taught us. Before the introduction of the electric motor, whose power can be readily ascertained either at any moment or for any period, we did not realize that the constant load did not exist, and even to-day it is difficult to make owners of plants realize the extreme variability of its use in their particular mill. In one instance, to which our attention has been attracted, the managers of a cement plant would not believe that their machinery, for which they had contracted to take a minimum of 1,000 horse-power with a maximum of 1,200, was actually averaging 600 horse-power and taking a maximum of 2,000. Therefore, first remember this, that the minimum horse-power of your plant cannot be multiplied by any constant figure to determine your revenue. If there be storage at all available, a knowledge of the character of the market will enable one who is competent to determine the horse-power hours and from this determine the revenue.

Therefore, we wish to state as the first point in establishing our criteria for the value of a water-power development, that the minimum flow of the stream shall not be considered as the true basis for valuing the water-power and determining the revenue, but that the total number of kilowatt-hours per year which may be developed from the stream and applied to the market, forms the proper basis of comparison. The common rating of cost per horse-power of minimum flow, is a false rating which results in the undervaluation of many such properties. The true valuation is on the basis of kilowatt-hours per year which may be used, and this depends, not only upon the character of the stream, but also upon the character of the market.

But what must we say of the market? Is it true to obtain it from statistics of the steam machinery in use? Let me ask you in return whether you would so estimate the field in other lines of other business? Is the successful man the one who establishes new plants in well-covered territories, or the one who develops new fields?

The power market is to be judged upon the same lines as the railroad business, to which it is closely related. To break into a well-occupied territory necessitates that you approach it with new advantages over those already in the field, though success in it results in the easy reaping of rich rewards. On the other hand, pioneering does not pay. The good judge of a territory will decide, not whether the power is already being employed, but whether the situation is such as to enable the future use of the power at enhanced prices. The fact that a territory barren to-day is likely to be the high-priced market of to-morrow, is almost invariably neglected and markets sought where both to-day and to-morrow the competition of steam is keen. This, as has already been said, is the practice in no other similar investigation and is contrary to good business principles. The outcome of this false point of view has been a business cowardice resulting in inadequate provision for the actual difficulties. Plant after plant has been developed where the business judgment of the promoter has been superior to that of the combined engineer and financier, to the end that, although money has been furnished and the installation made, the work has been done so grudgingly as to invite failure; a failure fortunately more often of the engineering than of the business project.

In the North, South, East and West we can find examples of financially successful plants where, in some essential engineering detail, reconstruction within five years after original construction has been necessary, with a resultant total cost much beyond that warranted by the results accomplished. By the score, we can count the instances of this evil economy and point to dams and power-houses washed away, pipe lines burst or collapsed, stations and sub-stations destroyed by fire, pole lines too weak for their burden, until the wonder of financial success, in spite of it all becomes greater and greater.

As we examine the subject the conclusion is forced in upon us from every side that, as water-power development stands to-day, there is too little of business about it and too much of the element of speculation, and this, not on account of any speculative element in the problem, but only because we have not yet developed a class of business men devoting their time and energies to these questions. Nothing in the nature of the problems presented warrants this result—a conclusion based upon considerable personal study of the problem in the far West, where power development and transmission has become a successful business; where some of the best men in the community have given themselves up wholly to its needs and where they have wrought great financial successes out of conditions which would have allowed their powers to remain forever undeveloped, if left to decisions based upon such investigations as I have been describing.

Why indeed should not power development and transmission be straight business and no speculation?

New England is what she is to-day by reason of her citizens who have been wise enough to develop her water-power resources, and the South is only becoming her rival as she has learned to appreciate the opportunities for similar development.

The coal wealth of the Alleghenies has raised coal mining from a speculation to

a business, and yet the best coal mine is a property of daily less and less value, for the coal which is mined is lost; but the flowing river must flow while the earth is habitable and every thousand horse-power it is capable of producing is equivalent to 12,000 tons of coal per annum, and will be while men line and manufacture.

In our national opulence we have not appreciated the value of this form of wealth inherited with our country, and in spite of the many hundred thousand horse-power we are already utilizing, and of the many million horse-power hours the past century has utilized from our numerous streams, we have only as yet begun to somewhere; as often as not coupled to the American market. In a larger way, she is saving coal by her water-powers for the operation of lights and tram lines wherever it is possible, to such an extent that a large majority of Swiss electrical water-power developments are on streams where steam auxiliary is necessary and where our so-called conservatism would condemn the situation as unworthy of development.

The ground floor of the new pattern-shop building of the Berlin Machine Works, at Beloit, Wis., is to be given up to the use of the men. Those who do not go home to dinner will have a dining room there. Rooms connected by three archways, with a floor space of 2,700 square feet, will be fitted with lockers where the men can keep their clothes, with a lavatory, tables, benches, magazines, with places to heat coffee and smoking will be permitted all through.

A special power plant for the United States Capitol in Washington is to be erected at a cost of $1,500,000. The location selected is a reservation known as Garfield Park, but there is talk of changing it to get better water facilities. Advertisements for bids are to be issued about August 1 and the specifications will be ready for distribution about that date regardless of the unsettled question of location.

Notes on Cranes—Gantries.

BY A. D. WILLIAMS.

A gantry is a bridge mounted on A-frames or towers, and, for crane purposes, a trolley is carried on the bridge. Stationary and movable gantries are extensively used. Cranes of the gantry type are employed almost exclusively for outside work in yards, on docks, etc. The principal advantage of the gantry is that an elevated runway is not required, and the most serious objection to this type of crane is that in distributing material along the runway the weight of material handled is very small in comparison to the weight of the crane moved. It is, however, susceptible of many modifications to suit special lines of work, and is particularly suited to handling large quantities of bulk material with rapidity along its bridge.

FIG. V. CANTILEVER CRANE AT THE CRAMP SHIPYARD.

Gantries with a single span of 300 feet have been built, but shorter spans are usually employed. Very long spans can be divided by using an intermediate tower, through which the trolley runway is carried. These cranes can also be provided with hinged aprons extending beyond the tower up to about 60 feet overhang, or with stationary cantilever extensions up to 175 feet.

Cantilever cranes are a modified form of gantry, in which the two end towers

skim the cream. Even New England is yet full of undeveloped water powers where development would pay handsomely and will in future enable New England to recover the commanding position which it is now becoming fashionable to take away from her.

Should we need an example to encourage us, we may look to Switzerland, a country which, in spite of all our Yankee ingenuity and economics of manufacturing on a great scale, has, and does yet defy us, holding to her own by simply not neglecting her opportunities. There, almost every stream which would fill a two-inch pipe has a water wheel on it an embroidery machine working away for

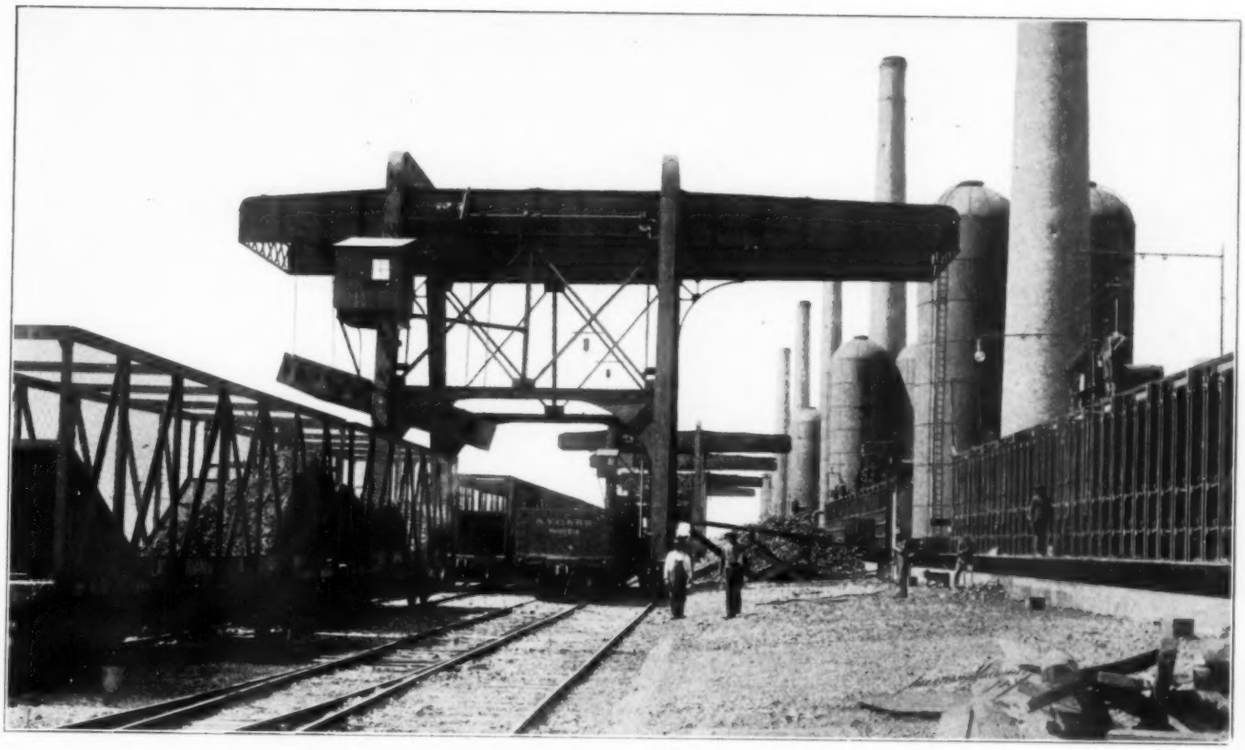


FIG. 2. COKE-HANDLING GANTRY CRANES.

FIG. 3. GANTRY WITH FOLDING APRONS.

are combined in a single central tower. In some of these machines the trolley and load are balanced by a counterweight, which normally travels in unison with the trolley, but in the opposite direction. The counterweight is generally arranged so that it may be manipulated by the operator to permit of the machine handling increased loads with a corresponding reduction of the overhang or trolley travel.

A great many hand-operated stationary gantries are used in railroad freight yards for loading and unloading cars. The cars are spotted beneath the crane by a "shifter," and trucks can be driven under it, the load being lifted and racked out or in by hand power acting on cranks, or hand chains and rag wheels. Machines of this type have been found more convenient for freight handling than the more usual pillar jib crane with its limited radius. The jib also interferes with many loads.

SHIPYARD CRANES.

Cantilever cranes are used on wharfs for unloading boats, for spoiling the débris from large excavations, for yard work, etc. The length of trolley travel in some existing machines is 350 feet. In addition to hoisting and racking motions, these machines can be arranged to travel along a runway or to slew the load, or they may have both slewing and traveling motions. For shipyard work they cover two berths side by side, being mounted upon an elevated runway between them. Fig. 1 is an illustration of an electric crane of this type in use at the Cramp shipyard, which with its runway was built by the Brown Hoisting Machinery Company, of Cleveland, Ohio. The picture also shows at the left the keel of the United States battleship "Maine," and the frame of the Russian battleship "Retvizan" is at the right. The speeds and capacity of this crane are as follows:

Hoisting full load (30,000 pounds)—125 feet per minute.
Hoisting 10,000 pounds—350 feet per minute.
Hoisting 1,000 pounds—700 feet per minute.
Trolley travel (190 feet)—400 to 800 feet per minute.
Crane travel (600 feet)—400 to 700 feet per minute.
Clear hight under cantilever—105 feet.

The speed of travel depends upon the load and wind pressure, the minimum being with the full load against a wind of 30 miles per hour.

The full load can be carried 60 feet either side of the center, and 9,000 pounds can be lifted at the extreme position of the hook, 95 feet from the center. The machine is operated by a single electric motor, the different motions being obtained from it through friction clutches. The trolley is traversed by wire ropes winding on drums. Another crane of this type of construction at the plant of the Newport News Shipbuilding & Dry Dock Company is of the steam-driven locomotive class, carrying its own boiler. This machine has rotary motion, its radius being 65 feet, and it can be slewed at the rate of 1½ revolutions per minute.

For coal and ore re-handling plants these machines can be equipped with grab or drag buckets, for spoiling the débris from excavations self-dumping skips are used, and grab buckets for excavating.

For short-span gantries, the track wheels, like those of traveling cranes, are often depended upon to hold the machine in line or square with the track. To attain this result, even approximately, the connections between the A-frames and the bridge girders, and the girders themselves, must be designed with this end in view, and heavy portal bracing is required to hold the towers or A-frames to gage. Wind stresses must be considered in designing the structure and traversing mechanism and for the wheel loads on the runway. An essential part of the equipment is a set of track clamps or anchors. It is dangerous to leave a yard crane unattended, unless it is anchored. The neglect of this apparently small matter has resulted in some costly wrecks, in which both the machine and adjacent buildings have been damaged.

LONG-SPAN GANTRIES.

For long-span gantries rigid connections between the bridge and A-frames are impracticable. It is impossible to move both ends of the machine in exact unison, and for many purposes it is undesirable. In fact a flexible structure is generally more convenient and durable for these machines than is a rigid structure. On tangents the flexible gantry runs on three or more parallel lines of rails; on curves the single-track tower runs on a curved track, the double tower being swung on a turntable. For very long bridges having three towers, the intermediate tower runs on two lines of rails, and the end towers are single. The bridge is pivoted at the apex of the towers, which are usually so arranged that the trolley can pass through them on to the apron or cantilever beyond. Unless a "man trolley" is used, the double tower carries the operator's cab and the machinery, this tower being often arranged to span a standard-gage railroad track. The machinery can be driven by steam or electricity, as is most convenient. In electrically operated machines

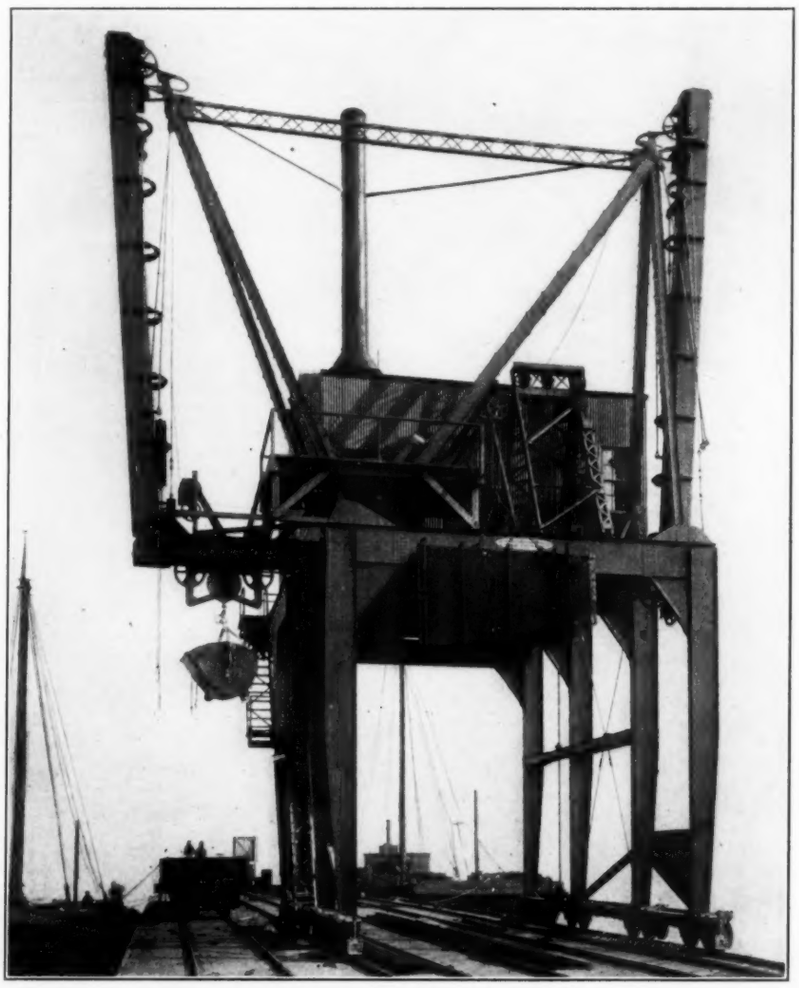


FIG. 4. GANTRY WITH FOLDING APRONS.

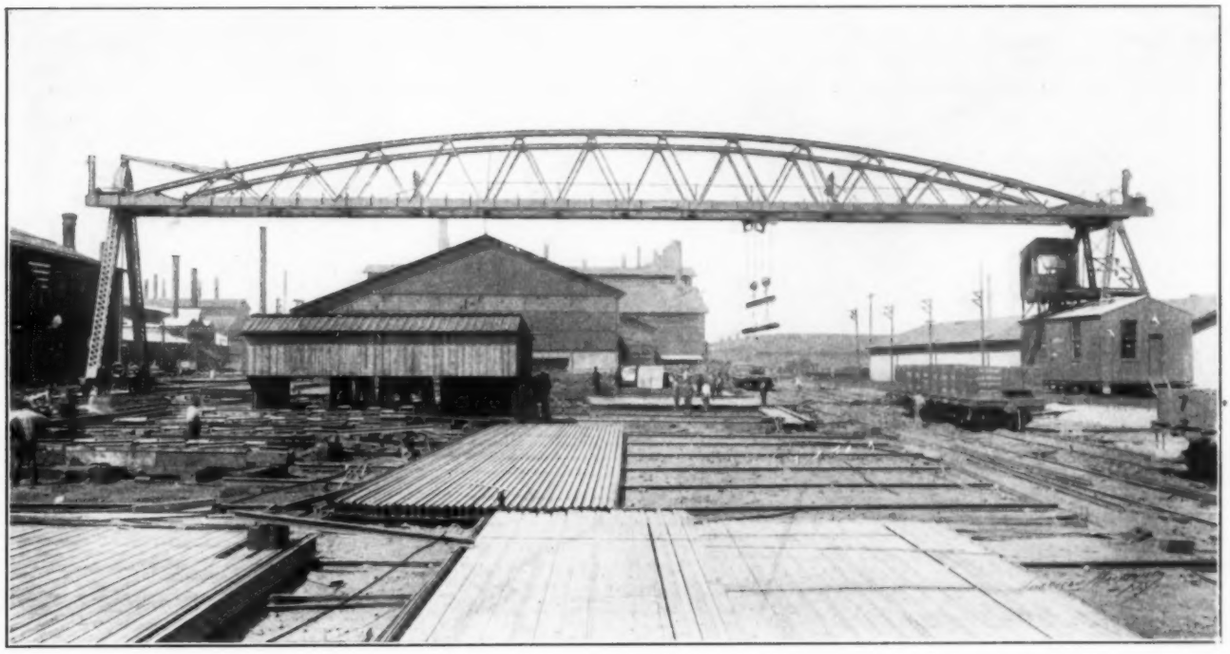


FIG. 5. GANTRY OF 168 FEET SPAN.

the operator's cab is often suspended from the trolley (which in this case is called a "man trolley"). The flexible construction permits considerable variation in alinement, which is of advantage in unloading boats or placing ore in bins at the furnaces. In some two- and three-tower machines the single towers can be shifted 50 feet either side of their normal positions without moving the double tower. These machines can be arranged so that all the towers can be moved independently or together by power. A usual construction for ore dock service is that in which the double tower is moved by power and the single tower by hand or by tackle connected to the hook.

COKE-HANDLING GANTRIES.

Fig. 2 shows five 20-ton coke-handling gantry cranes built by the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, and used for loading cars at the by-product coke oven plant of the Lackawanna Steel Company at Buffalo, N. Y. These machines have cantilever extensions and span two railroad tracks. The

FIG. 6. HULETT ORE BRIDGE.

coke ovens are shown at the right. The coke is pushed from the ovens by a special machine operated on tracks on the opposite side of the battery, coming from the oven hot and dropping into a pan, one of which is seen suspended from the crane in the foreground, where it is quenched by throwing streams of water on it. The crane is equipped with four falls, which can be operated all together, for lifting the pan, or as two independent pairs for tilting it and discharging the coke into special bottom dump coke cars which load through their tops. Some of these cars can be seen at the left.

BOAT-UNLOADING GANTRIES.

Figs. 3 and 4 show a gantry with two 36-foot folding aprons, as built by the Brown Hoisting Machinery Company. This machine is called a "fast plant," and was built for the rapid handling of bulk freight from boats to cars or in the reverse direction. It is particularly adapted to the handling of coal, broken stone and similar materials. An expert operator has been able to load 1,000 tons of broken stone from barges into gondola cars in one day, an average of 100 tons per hour. A special chute for loading box cars can be seen hanging at the side of the machine. On the Lake Erie ore docks a number of these machines are used. The "fast plant" here shown is a steam-driven machine; an electrically driven machine is illustrated further on. At the end of the track beams in Fig. 4 the track clamps used to anchor the machine can be seen just over the rails.

RAIL-HANDLING GANTRIES.

Fig. 5 shows a "Brownhoist" gantry, of 168 feet span, designed to handle rails or other lengthy material from the finishing mill to the storage beds or cars at the Pennsylvania Steel Works. It is provided with two trolleys which traverse and hoist in unison, and is shown with a special hook beam. The operating speeds of this machine are:

Hoisting, full load—200 feet per minute.
Trolley travel, full load—1,000 feet per minute.
Bridge travel, full load—800 feet per minute.

It will be noted that one end of the bridge is carried on a single tower, and a double or machinery tower is at the opposite end, the operator being stationed in the small cab above the machinery house. The bridge is supported by saddles on the towers.

ORE BRIDGES.

Fig. 6 is a Hulett ore bridge installed by the Wellman-Seaver-Morgan Company at the Ohio Steel Works, Youngstown, Ohio. This machine has a span of 260 feet over the stock yard, and a cantilever extension of 41 feet over the ore bins next to the furnaces. These bridges are operated in connection with car dumpers, which unload the railroad cars, in which the ore is brought down from Lake Erie, into small, 17-ton side dump cars, which are carried between the car dumper and the ore bridge by standard gage transfer cars drawn by a shifting engine. Some of the transfer cars with the dump cars upon them are shown in the foreground. The bridge is provided with a spotting device for locating the tracks on the transfer cars in line with the inclined tracks on the bridge, which avoids delaying the shifting engine for this service. A haulage rope is then attached to the dump cars and it is run off the transfer car and out on the bridge, where it dumps automatically at any point desired. The sides of the car latch as soon as it is relieved of its load, and the car is returned by gravity, its speed controlled by the haulage rope, to the transfer car.

The cars can deposit their loads on the stock pile under the bridge or from the cantilever into the ore bins, or to a bin-charging larry running over them. Below the track upon which the cars are run is another track carrying a trolley which operates a 10-ton grab or drag bucket by means of which ore is handled between the stock pile and the bins. This machine is operated by two men, one of whom is stationed in the cab carried immediately over the transfer car tracks in the double or machinery tower; the other attends to spotting the transfer cars and shifting the haulage rope. The machinery is driven by two 130 horse-power electric motors, which also operate the bridge traverse; the speed along the runway is 50 feet per minute. Its capacity is about 400 tons of ore to or from the stock pile per hour. The bridge is intended to operate at all times in square with the runway, but is so hung that the unavoidable irregularities of its traverse do not rack it.

STOCK PILE BRIDGE TRAMWAYS.

Fig. 7 shows a "Brownhoist" bridge tramway with a "man trolley" in use covering the stock pile at the Pittsburg and Conneaut Dock, at Conneaut, Ohio, which only requires one man to operate it. This machine is used entirely in rehandling ore which is taken from boats lying at the dock by the unloaders shown in Fig. 11. The operator travels in a cab attached to the trolley. The transverse of the bridge is controlled from the small platform to the left of the double tower, where the controller can be reached without leaving the cab. The following are the data in regard to this machine:

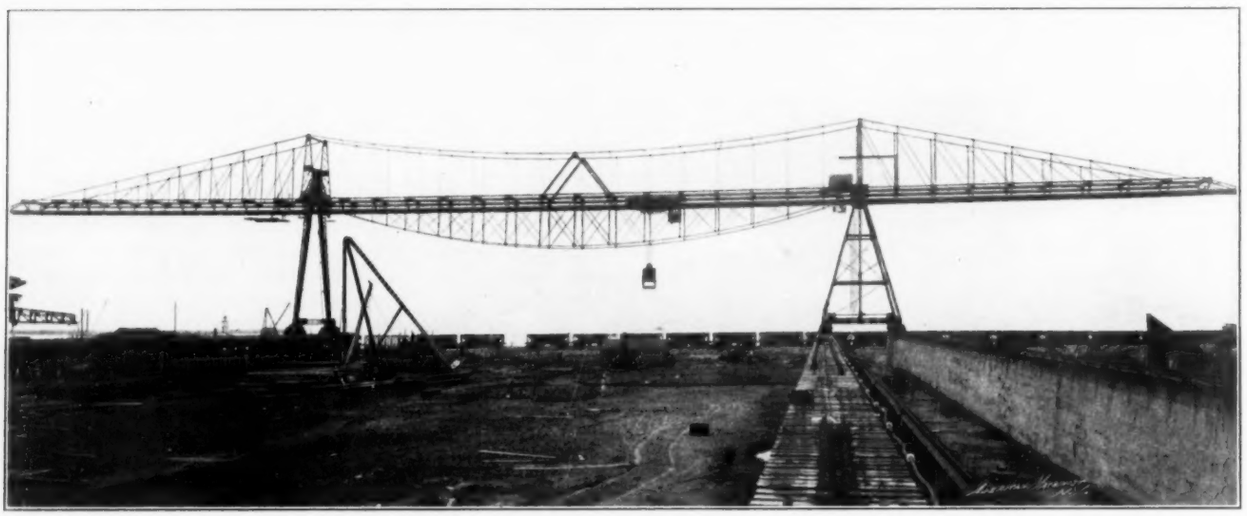


FIG. 7. BRIDGE TRAMWAY.

Capacity of grab bucket—14,000 pounds.
Capacity of hook—28,000 pounds.
Total weight of crane—1,039,000 pounds.
Total weight of trolley and bucket—69,000 pounds.
Speed of hoist—225 feet per minute.
Speed of trolley travel—1,000 feet per minute.
Speed of bridge travel on runway—75 feet per minute.
Motors for hoist—Two 150 horse-power.

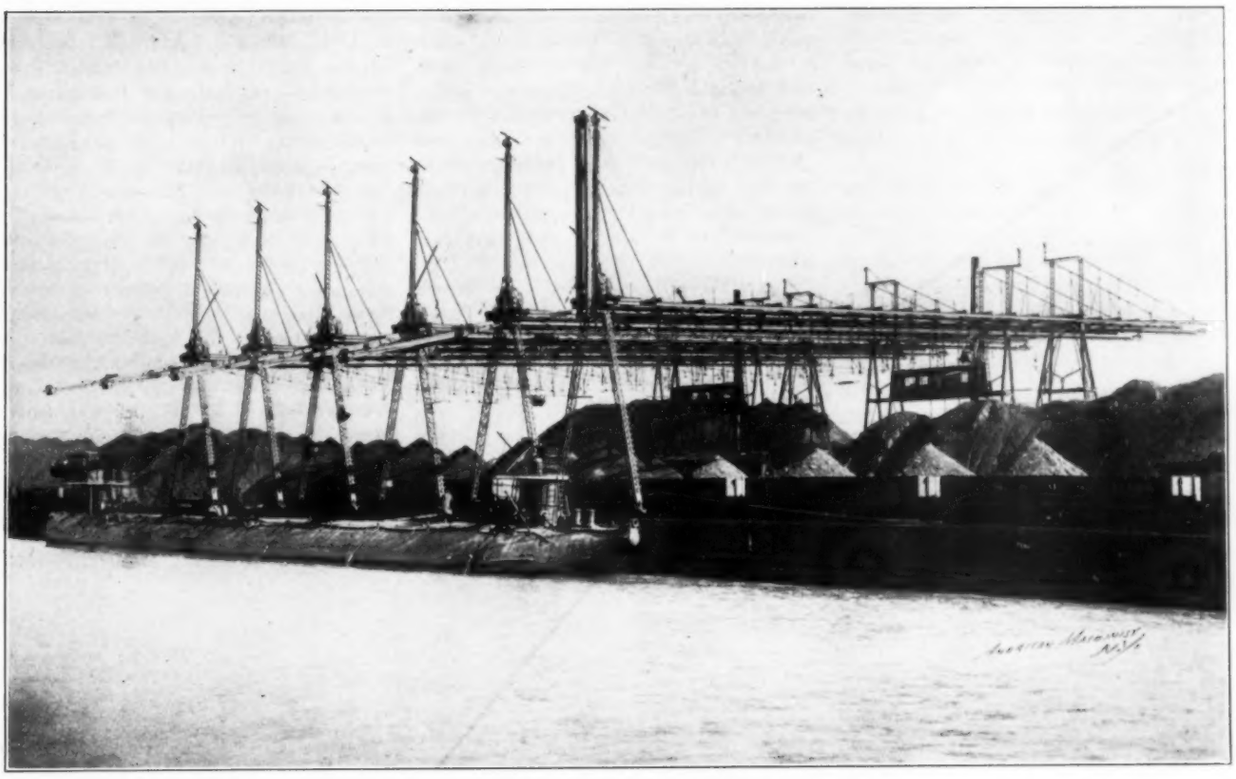


FIG. 8. SIX BRIDGE TRAMWAYS.

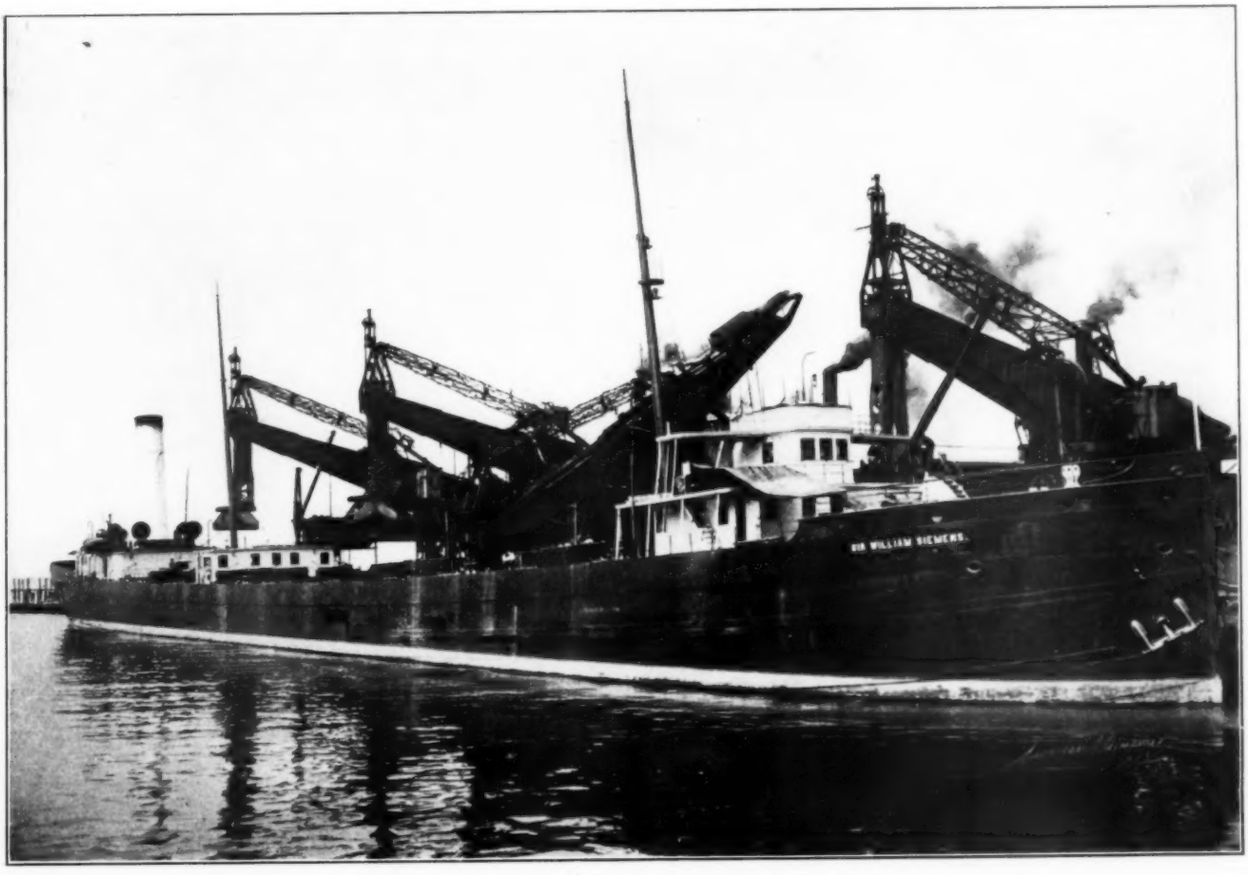


FIG. 9. HULETT UNLOADERS.

Motors for trolley travel—Two 75 horsepower.

Motors for bridge travel—One 150 horsepower.

The extreme length of the bridge is 552 feet, and the length of the trolley travel is a few feet less, the cantilever at the left is 154 feet long, from center to center of towers is 250 feet, and the cantilever at the right is 148 feet long. The hight under the cantilevers is 67 feet.

BOAT UNLOADERS.

Fig. 8 shows an installation of six "Brownhoist" bridge tramways erected some years ago at Ashtabula, Ohio. These machines have folding aprons that can be raised to allow a masted boat to dock, and cantilever extensions at the rear. In this plant the boiler and other machinery for operating three bridges is placed in a house carried on a pair of double towers, which also support two of the bridges, all as shown in the background, the third bridge having an independent rear tower. An operator is required for each bridge, and one fireman, and a signal man is stationed where he can observe the hold of the boat and signal to the operator by means of the semaphores seen at the top of all the towers. A number of shovelers are required working in the hold to fill the tubs, which are then hooked on the fall, hoisted and run back, automatically dumped, and returned to the hold of the boat by gravity. The tubs used hold about 17 cubic feet, 2,000 to 3,000 pounds of ore. The lower block is hoisted to the trolley and automatically locks there until it is released by the return of the trolley to its starting point. The plant shown has an average capacity of 240 tons per hour, the machine making a round trip involving 600 feet of trolley travel in addition to the hight of hoist in one minute, and higher speeds have been reached. A large number of similar machines have been built by the Brown Hoisting Machinery Company and others, some of which have been rebuilt to operate grab buckets. In addition to unloading from boats on to the stock pile, these machines can be used to load cars and boats.

Fig. 9 shows four Hulett steam driven unloaders on the Pittsburg and Conneaut Dock, and Fig. 10 shows three of a battery of five electrically driven machines at the plant of the Lackawanna Steel Company. The gantry of the Hulett unloader has a track gage of about 70 feet, and spans four or five standard-gage tracks, upon which cars to be loaded can be placed. A trolley upon the gantry carries a walking beam, having arms about 50 feet long, from the outboard arm of which a vertical leg is hung, which is kept perpendicular by the upper lattice strut, a well-known parallel motion device. The grab bucket, which has a capacity of 10 gross tons, is carried by the vertical leg. The bucket operator, who controls all the motions of the machine except its traverse from hatch to hatch and the motion of the hopper car, travels in this leg immediately over the bucket. The bucket can be swung around its vertical axis, to reach ore between the hatches, and is opened and closed by hydraulic power, the water pressure being 1,000 pounds per square inch, a steam or compressed-air accumulator being used in conjunction with suitable steam or electrically driven pressure pumps. The normal opening of the bucket is 18 feet, but an additional reach of 2½ feet is available for scraping. The cantilever on the Lacakawanna machines has an overhang of 158 feet. The walking beam is a box girder section having a depth at the center of 6 feet, the fulcrum pin being 24 inches in diameter.

At the front end of the gantry is a stationary hopper into which the ore is dumped from the bucket. A dump car, whose motion is controlled by a haulage rope, travels beneath the stationary hopper between the girders of the gantry, receives the ore from the hopper and transfers it to a position over the railroad car being loaded, or, as at the Lackawanna plant, it is run back over the stock pile, where its load is discharged as shown in Fig. 10.

In the operation of this machine, the trolley is moved forward till the open bucket is over the hatch of the boat, then it is lowered, filled, raised and the trolley run back, and the ore dropped into the hopper below. While the grab bucket goes for another load, the hopper is either discharged into a railroad car beneath it or into the dump car to be carried back and deposited in cars beneath the gantry or upon the stock pile. The operator who controls the motion of the machine along the dock and the travel of the dump car is carried in a cabin at the rear end of the gantry immediately beneath the girders.

The walking beam and grab bucket are lowered by gravity, and are raised by means of wire ropes working over sheaves on the inboard arm, the winding machinery being located at the rear end of the trolley which carries the walking beam. The hydraulic accumulator is mounted upon the inboard end of the walking

FIG. 10. HULETT UNLOADERS.

beam and is quite plainly shown upon the second machine in Fig. 9. It looks something like a cannon. The total weight of the Hulett unloader is between 400 and 500 tons.

On July 25, 1904, the four steam Hulett unloaders at Conneaut, working in conjunction with the four "Brownhoist" unloaders shown in Figs. 11 and 12, unloaded the steamer "Augustus B. Wolvin" in four hours and thirty minutes, handling in this time 9,945 tons of ore. The Hulett machines, equipped with 10-ton buckets, took out 7,257 tons, an average of 1,814 tons each, their average time in use being four hours and six minutes, and the average hourly tonnage of each machine, 453 tons. One machine took out 681 tons in one hour. The four Brown machines were equipped with 10,000-pound grab buckets, handled 2,688 tons, an average of 672 tons each, their average time in service being three hours and forty minutes, and the average hourly tonnage of each machine, 187 tons. Fifty men were employed in the hold shoveling during the last hour. The vessel was in this case unloaded in less time than it had taken to load her at the head of the lakes, where the ore is spouted in from bins on the piers, but in loading a boat of the size of the "Wolvin" several shifts along the dock are required, which consume time. The Brown machines on November 9, 1904, took a cargo of 9,306 tons out of the "Wolvin" in fifteen hours and thirty minutes, fifteen shovelers being in the hold during the last three hours and thirty minutes.

Fig. 11 shows the Brown Hoisting Machinery Company's "fast plant," as designed for unloading iron ore. The front machine is ready for work, the two machines in back of it having their aprons raised. At the right, in such a position that it appears to be an extension of the fast plant cantilever, is seen the cantilever of the bridge tramway shown in Fig. 7. In the background can be seen the Hulett unloaders shown in Fig. 9, and between the tracks in the foregraund can be seen the haulage ropes used for shifting cars. This machine requires but one operator, who travels in the cab attached to the trolley, from which he can control all the motions of the machine, the controller levers for the bridge travel, the apron hoist and for shifting the car-loading hopper being located on a small platform beneath the bridge, where they can be reached from the cab. The hoisting gearing is mounted upon a turntable, so that the buckets can be swung around its vertical axis. The machine unloads from the boat into cars or to a pile from which it can either be placed in stock by the bridge tramway or loaded into cars by the fast plant. Four railroad tracks pass beneath the bridge, and there is room for a fifth. The following figures give an idea of this machine:

Length of apron—59.25 feet.
Span between towers—62.83 feet.
Cantilever extension—67.50 feet.
Capacity of bucket—10,000 pounds.
Capacity on hook—20,000 pounds.
Total weight of crane—337,000 pounds.
Total weight of trolley and bucket—59,400 pounds.
Speeds—Hoist, 300 feet per minute; trolley travel, 1,000 feet per minute; bridge travel, 75 feet per minute.
Motors—Hoist, two 150 horse-power; trolley travel, one 100 horse-power; bridge travel, one 75 horse-power.

Where ton is mentioned herein, the gross ton of 2,240 pounds is intended, that being the unit for measuring iron ore.

FIG. 11. BROWN HOISTING MACHINERY COMPANY'S UNLOADER.

Using Present Sunlight Instead of Ancient Sunlight.

The various sources of energy on the earth may be divided into two kinds, viz., "income," as arising from the daily receipt of thermal, etc., energy from the sun, which consists in the growth of vegetables of all kinds, of stored energy in elevated water, etc.; and of "savings" which consist of stores of vegetable products such as coal and petroleum, etc. At present we are making a most inordinate misuse of the latter, while, so far, we are in the main ignoring the lavish annual donations from Helios. Mr. D. E. Huschins, of Cape Colony, after many years' study has found that it is cheaper to plough and sow eucalyptus than to im-

port coal, the dry timber being asserted to be far more efficient than imported coal and greater in thermal value, bulk for bulk. We give this for what it is worth, and may say that it is a speculation that has been exercising our minds for over twenty years, and for which we believe there is still a solution to be found of value inestimable to humanity.—*Indian Elec., Mech. and Textile News,* Bombay.

Some Things Found in a Hand-Book.

BY W. OSBORNE.

When I was a small boy I used to have a certain story told to me. This story was about a boy who was getting a thrashing, and instead of his setting up the howl that such a demonstration usually produces, he was convulsed with mirth. The harder he was whipped the harder he laughed. The teacher was whipping the wrong boy, and this boy's sense of the ridiculous was more acute than his sense of pain, and so he saw the funny side.

Perhaps most of us have been on each side of that situation at some time in our lives. I have often wondered just how the teacher got himself out of it gracefully. I can sympathize with him as well as with the boy, and lately I have had to conclude that perhaps I at some times have been somewhat like him. I have often envied those fortunate beings who can learn a thing and know it, and know it for good. I have often envied the man who can have his knowledge without any shadow of doubt or mistrust. I have so often found that the things I knew yesterday I do not know to-day. The things which mean something in arithmetic mean something entirely different in another part of mathematics, or in another part of the country.

Perhaps you do not believe this last statement of what I have discovered, but I would say that when I was even a smaller boy than when I first heard that story of the whipping which was applied in the wrong place, I had drummed into me a statement like this: "Two into six is three." Now, I find that sometimes it is three, as it used to be, and sometimes it is twelve; and when I demand an explanation of the latter statement I am told that "The *product* of two into six is twelve, while the *quotient* of two into six is three." I find that the fellow who said in that old book that "*plus* means addition; *minus*, subtraction; *times*, multiplication; and *into*, division," did not tell me right when he told me this was *always* so.

While all of these statements might have been put into more nearly correct language, that is not my objection to them; but it is a fact that there is a doubt in my mind as to the meanings of some of them. I act on the supposition that one meaning is right, and after I find that the results are not as they should be, I find that I have misunderstood the real meaning. Then it may be too late for me to do anything but to learn caution.

I find that even those whom we look on as very good authorities do not always give us very clear charts of the sea of experience over which we all must sail. I have sometimes spoken of the shortcomings of some of the technical men with whom I have come in contact, and whom I did not consider very practical; but perhaps I have been whipping the wrong boy, too—at least it may be that they did not deserve all the whipping.

My mechanical library has been made up of such books as I have needed from time to time, and for the sake of getting it condensed as much as possible I have always had a supply of handbooks. These I have looked upon as giving the collections such as practical men have needed, and I have looked upon them as working tools more than text books.

Having occasion to hunt up some matters lately, I came across some statements in one of the latest, and supposedly one of the best of them, and now I think that perhaps the young man who may use it as a chart to steer by in the beginning of his voyage of experience on the sea of mechanical engineering may not be altogether to blame if he makes the various ports under difficulties.

My trouble with this book started by the blacksmith asking me how he could best get the weight of octagon stock. He wished to be able to figure its area, using the ordinary measurement across as the starting point.

After failing to find any table showing weights of octagons, I found a nice table of polygons, which I imagined must be the very thing. Here was a column headed "Areas"; but, alas, I am *sometimes* busy, and the blacksmith is generally busy. Perhaps such tables are not to be trifled with by common folks who want to save the price of a pair of scales.

Then there is the matter of compressed air that I want to know about, and in turning to it I see the statement that a compression of thirty atmospheres, if no cooling takes place, gives a temperature of about 875 degrees, and the statement: "This is ample to ignite the heaviest oil injected into the cylinder." I hunt all over the book, and over several others, and fail to find anything that will tell me what temperature is necessary to start combustion. I would like to know what temperature is necessary to start combustion in wood and coal and lamp oil and gasolene and gases and paper and lots of other things, and this one statement is the only thing I can find. After seeing the statement made so positively, I thought I had found the very authority that knew all about it; but I hadn't.

I did find some other things which made me have more charity for the young student without practical experience in the world. Under the head of "Machine Design" is a statement as follows: "For connecting shafts which are placed at an angle with each other the universal joint is employed." An illustration is given and also a table showing the irregularities, but there is nothing that I could see that would lead one to suppose that there was any other way to do this. Can it be wondered that some people are misinformed on some subjects, when this handbook of 1905 says, "Practically all of the internal-combustion motors now in active use are operated on the Beau de Rochas cycle, with a power impulse every fourth stroke." In view of the thousands of two-cycle engines which I know are running in this country, giving a total horsepower to be measured by the hundreds of thousands, I wonder what meaning to give to this word "practically."

I had an opportunity to examine this handbook before I bought it. The letterpress work was simply charming: nice paper, new type, and work well done. Along near the front was given a way to get a close approximation of the root of a number, and it was very easy to use, especially in finding the square root. It was not the finding of the way that so much pleased me as it was the finding of a man who would get out a handbook and yet believe in an approximation. Surely here was a "practical man," in spite of his high learning. I am afraid I said and thought some very nice things about that book on insufficient evidence. It may be that a "barrel" is not a "standard volume," but at the same time it might be very convenient to know what the "trade" means by a barrel in the things which are sold and charged for by the barrel. A barrel of crude oil is always 42 gallons; but then a mechanical engineer in a drawing room may never need to know that. I have known some who would like to have known the cubical contents of a "barrel" of cement.

I did not start to criticize the handbook, for it is a very good one, and I keep it on my desk alongside of "Kent's"; but it has caused me to feel more charity for the young man who takes some of the remarks such as I have called attention to for "gospel truth." After seeing what is in the book, and hunting for some things that are not in it, he may get a wrong idea of the relative importance of things for surely the important ones will be in the book, or at least he may reasonably suppose so. After a while it may come to him that, while the scientific principles involved may be of great importance, it may at the same time be well to give "the practical application" of them some consideration also.

After doing the best one knows how and getting a very successful answer to an attempt to practically apply principles to a case in hand, further consideration often shows that the answer is not the best one, and that there isn't any book with the answer in it.

Letters to the Editor.

Grinding Fixtures.

Fig. 1 is an interchangeable tool-steel part which was required to be ground taper on one side, as indicated. This part consisted of two accurately machined pieces, which were held together by five rivets. In producing the articles the larger pieces were punched from sheet-steel strips, the holes for the rivets were pierced and countersunk, then the sides of the part were milled and then it was hardened and tempered. After this the surface *A* was ground, and then the dovetail piece riveted to it as shown. After assembling, the smaller or dovetail piece was shaved on the edges to insure interchangeability. The variation in the ground part was not to exceed 0.0005 inch.

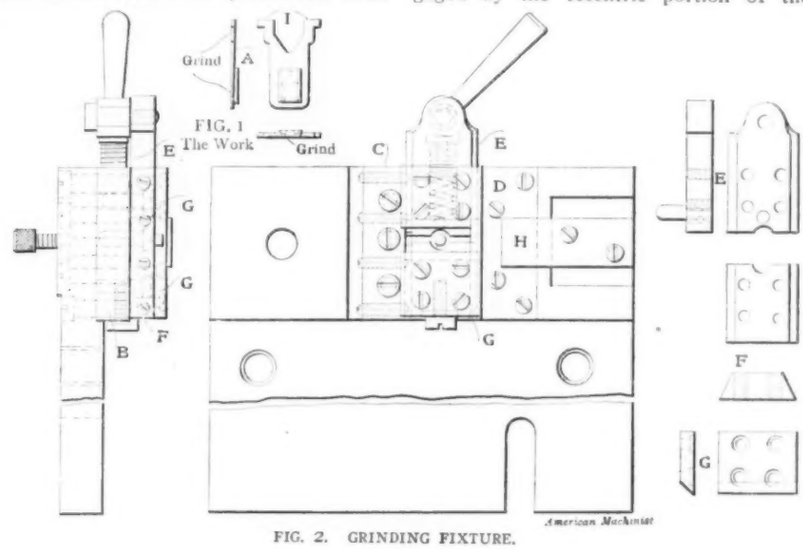


FIG. 1 The Work

FIG. 2. GRINDING FIXTURE.

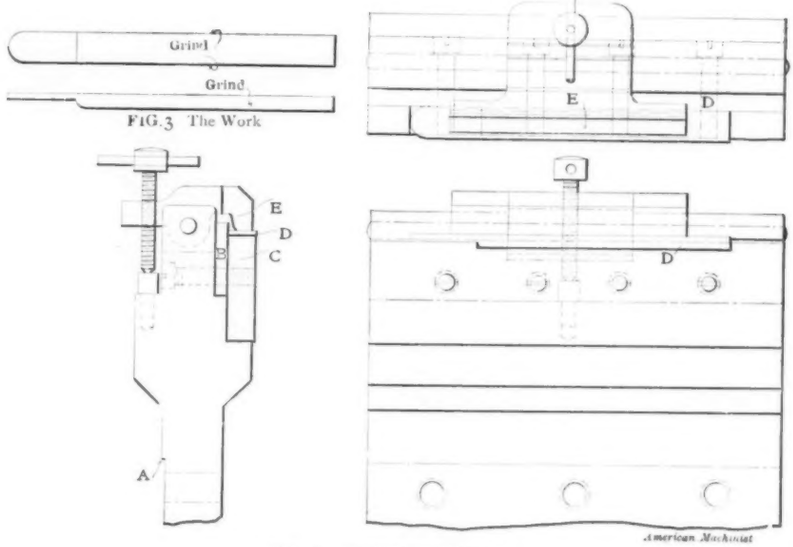


FIG. 3 The Work

FIG. 4. GRINDING FIXTURE.

Fig. 2 shows the grinding fixture complete and also a few of the details. The body is of gray iron, with holes and a slot for the bolts which fasten it on the cross-slide of the grinder and in alinement with the cup emery wheel. *B* is a machine-steel plate fastened to the base by filister-head brass screws, let in from the back; *C* and *D* are two guides between which the dovetail slides *E* and *F* fit; *G G* are the work-holders and locators. A filister-head screw adjusts *F*, and an eccentric lever raises *E*. At the rear of the latter is a headless screw, which regulates the tension of a spring acting upon slide *E*; this screw is engaged by the eccentric portion of the lever. The nurled-head screw tapped in from the rear of the base forms a seat against which the dovetail piece of the work rests. The plate *H* is the stop against which the wings *I* of the work locate when the fixture is in use.

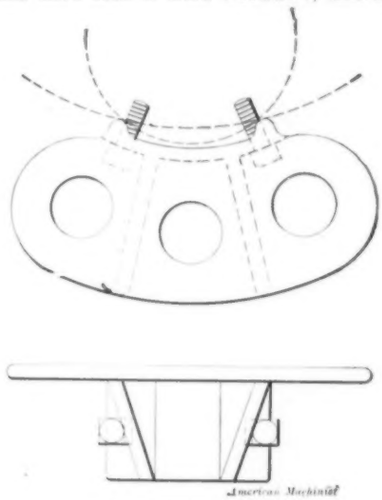
The fixture is clamped to an inclined surface on the grinder cross-slide, and when the operating handle is pulled to a vertical position, opening the jaws, the work is slipped in with the dovetail piece between the jaws and the wings against the stop *H*, after which the handle is pushed downward, when the spring engaging the pin in slide *E* causes the work to be clamped securely. The nurled-head screw is then brought against the work, the feed thrown in and the piece ground, using a good flow of water. Altogether, thirty brass screws were required to hold the parts together, there being of course no possibility of these screws rusting in under the action of the water.

Fig. 3 illustrates a tool-steel part which was accurately milled to shape, and then ground on its edges. The grinding fixture is shown in Fig. 4. The body is machined all over, with a ledge at *A* for locating the fixture on the cross-slide of the grinder, and in alinement with the cup-shaped emery wheel. The tapped holes are for the fastening bolts. *B* and *C* are two hardened and ground tool-steel plates, which comprise the seat for the work *D*. The latter is clamped into its seat by the tool-steel clamp *E*, which is hinged on a pin and operated by a thumb-screw, the point of which rests on a steel plug.

WM. DORAN.

Taking Care of Drill Chucks.

Some time ago I noticed an inquiry from a reader as to the best method of providing chucks for drill presses—whether such chucks should be left in the tool-room or each drill press be provided with the necessary outfit. We have tried keeping chucks in the toolroom, and have seen it tried elsewhere, and in most cases it was very unsatisfactory to the men, and in some cases disastrous to the chucks, since the management believed in keeping inexperienced boys in charge of the toolroom window. The damage done to a chuck each time it was out was not usually noticed until nearly all were in quite bad condition. By this method, a careless man often got a good chuck which he could further mutilate, and a careful man was often compelled to use one that had already been in the hands of the man who



DRILL CHUCK SHELF.

could be independent of chuck wrenches as long as his "trusty" hammer and center punch were at hand. Then, too, the workmen would in many instances retain the chucks as long as possible, and often not return them to the toolroom unless actually compelled to do so. From this we concluded that such a system was unsatisfactory, and a change was decided upon, and a different style of chuck adopted also, to meet better the requirements of the shop.

Enough chucks were secured to equip every drill press in the plant with a full set up to the capacity of the machine and these were numbered to correspond to the number on the drill press. A pattern for an iron shelf, like that shown in the sketch, was made, and a wedge and a spanner wrench —which, by the way, was adjustable— were secured by a peg and a piece of strong chain about 30 inches long to the right-hand side of the column at a convenient height to reach the chuck when in use. When not in use the chuck wrench and wedge were hung on the peg for the sake of neatness and convenience. As will be seen, the iron shelf was so formed as to adapt itself to small and large columns, and it was secured by two 5-16-inch tap bolts. The holes for the chucks were reamed taper to correspond to the shanks, and the sharp edges rounded to prevent marking.

Now, as the work of keeping tools in good repair falls to the toolroom, it becomes one of the duties of a member of the toolroom force to make a weekly inspection of the drill presses to ascertain the condition of the chucks, wrenches, etc. If anything is missing, it is searched for, and if not found a new part is supplied. If any mutilation is discovered, it is reported to the foreman, and in most cases the offender can be located and promptly "trimmed." Any repairs necessary are made and the tools returned to place as soon as possible.

Thus it will be seen that while the chucks are out on the machines, yet they are well taken care of, and as there are enough of them, all supplied with the necessary wrenches, etc., there is no occasion to borrow or exchange tools, and the hammer-and-center-punch fiend is without an excuse for multilating chucks.

W. M. F.

"Laying Off" a Punch.

The die being usually finished and hardened before the punch is made, it is used as a templet to scribe the working lines on the coppered face of the punch. A simple way to get an *exact* outline of the die, on the end of the punch, is to tin the end of the punch and then float a film of soft solder a few thousandths thick on the tinned end. Then place the die face up, with the soldered end of the punch in correct position on top of it under an arbor press, and make an impression of the die on the soft solder on the end of the punch. This gives a clear *correct* outline which cannot always be said of the scribing method.

DIXIE.

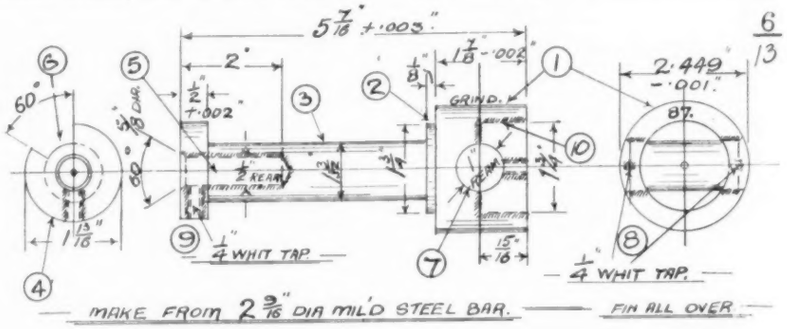
A Shop Drawing.

I am sending you a sample of a working shop-drawing, as used at present in the works where I am located. We aimed to get a drawing that would contain all the details and information necessary for the production of interchangeable work, from the rough stock to the finished article, and to have some permanent record of such work, the result of our endeavors being shown in the drawing sent.

With the use of these drawings, the foreman's responsibility is considerably lessened, and the draftsman's, of course, correspondingly increased, which gives the foreman more time to look closely after the management of his department. Where fine limits are necessary, the greatest possible that can be allowed is clearly stated. Where no limit is given, reasonable shop accuracy is expected; in other words + or — 1-64 inch from the dimension given. It is understood that the first dimension given is the required size, but if the work varies within the limit given, it will be accepted as first class.

Excellent results have been obtained since the introduction of the tool column shown, with a proper system of marking and storing tools. Very noticeable results have been: A better quality of work produced, a higher standard of ability among the men themselves and a reduction in the time.

The drawings are made in manifold books, of 100 pages, 10½ by 8 inches, the carbon copy being mounted on stout cardboard, properly bound and filed in the foreman's office when not in use. The books, when full, are filed in the works office, so that in case the shop-drawing gets destroyed or is in any way rendered unfit for use, there is a correct copy always to be had. It also keeps track of any alterations that may be made to the drawing from time to time and is in this way very often a "silent but truthful witness." First class blueprints can be made from the tissue copy, which may be re-



6/13

MAKE FROM 2 3/16" DIA MILD STEEL BAR. FIN ALL OVER.

	OPERATIONS.	TOOLS.
A.	HACK SAW. Cut into 5½" lengths.	
B.	CENTREING M/c. Centre drill both ends.	Medium drill.
C.	LATHE. Face ends, turn dia's ①②③ and ④ to dimensions given, leaving grinding allowance on ①. Face to lengths to Gauge N° 2. Polish ②③ and ④. Hold by ① in chuck, run ④ in steady, and bore, ream, and c'sk hole ⑤ as shown.	Gauge N° 1. 31/64" drill. ½" reamer. ½" limit gauge 60° C'sk.
D.	MILLING M/c. Hold work on centres, and mill out at ⑧ with Form Cutter N° 2.	Index centres Form cutter N° 2
E.	UNIV GRINDER. Grind dia ① to size given.	
F.	DRILLER. Hold in Jig N° 3, drill holes ⑦⑧ and ⑨. Remove bushing and ream hole ⑦ with Reamer N° 4. to 1" limit gauge.	Jig N° 3. N° 3 and 53/64" drills Reamer N° 4.
G.	LATHE. Hold in chuck, bore out at ⑩ as shown.	
H.	FITTER. Tap holes ⑧ and ⑨. Remove all burrs. Finish off, and stamp Part N° as shown.	¼" WHIT Taps. ⅛" Figures.

PLUNGER.—Z.A. 87.

N° 8 AUTOMATIC M/c.

Hough 24-6.05

A SHOP DRAWING.

moved from the book, and replaced with a little paste. It may interest you to know that the draftsman's time for the drawing shown works out at about 1½ to 2 hours.

THOS. A. HOUGH.

Leicester, England.

Automatic Vise for Hand Milling Machine.

This automatic vise has proved to be a valuable time-saver on repetition work handled on the hand milling machine. Its action is simple, its method of construction makes it as strong as an ordinary vise, while the advantage of dispensing with the tightening screw and operating with the table-feeding lever is obvious.

On a machined surface on the casting *A* slides the gray-iron block *B*, which may be clamped in position by the tightening screws *C*, after being adjusted by the set-screws *D*. The fixed jaw *E* is fastened to *B* by means of two screws. Free to oscillate on a machine-steel fulcrum *F* is the gray-iron block *G*, which carries the movable jaw *H*, and inserted in the block *G* is a tool-steel strip *I*. Secured in the casting *A* by means of a nut is the machine-steel shaft *J*, to which is keyed the gray-iron block *K*, carrying roll *L*. At one end of *K* is pinned the gray-iron arm *M* into which is screwed the pin *N* carrying roll *O*. Attached at a convenient spot on the milling machine are adjustable stops *P* and *P'*.

The method of operation is briefly as follows: Assuming that the loose jaw *H* is thrown back, the piece to be milled is located on the jaw *E*. The vise is fed along by the table-operating lever until, before the work reaches the cutter, the roll *O* comes into contact with stop *P*, actuating shaft *J* and causing roll *L* to travel up the surface of the casting *G* and close jaw *H* on the work. The steel strip *I* is so placed as to receive the pressure of the roll *L*, when the latter is compressing the jaws. After the work is passed under the cutter the roll *O* comes into contact with the stop *P'*; this causes the roll *L* to travel downward, freeing the block *G*, which is forced open, upon the roll *L* contacting with the lug *Q*. The operator may then remove the work and locate another piece to be machined, as before. Unless the method of locating the work in the vise is such as to take up an unusual amount of time, the feed may be maintained continuously.

Variations in thickness of stock to be milled may be taken up by slackening *C* and sliding block *B* as required. Should the strip *I* require adjustment, owing to wear or for any other reason, it may be obtained by slackening the screws and sliding it in its groove. The back of the block being cut on a taper, and the groove in the casting milled accordingly, any movement of the block will result in the adjustment of its wearing face. The vise is, of course, designed for work of a fairly light character.

C. F. H.

Setting Accurate Boring-Mill Work.

At a factory where I worked some time ago a lot of trouble was experienced in a certain class of boring-mill work. The nature of the work is shown in the sketch Fig. 1, and the trouble lay in getting the distance *A* correct. This dimension varied in different pieces from 18 inches to 3 feet, and had to be within .0003 inch of the given size. Originally, the method of producing the work was this: The casting was first planed or milled on its base, then placed on the table for laying out. The base was then clamped to an angle-plate on the boring-mill table and set up to the lines. This setting-up took quite a little time; moreover, when the job *was*

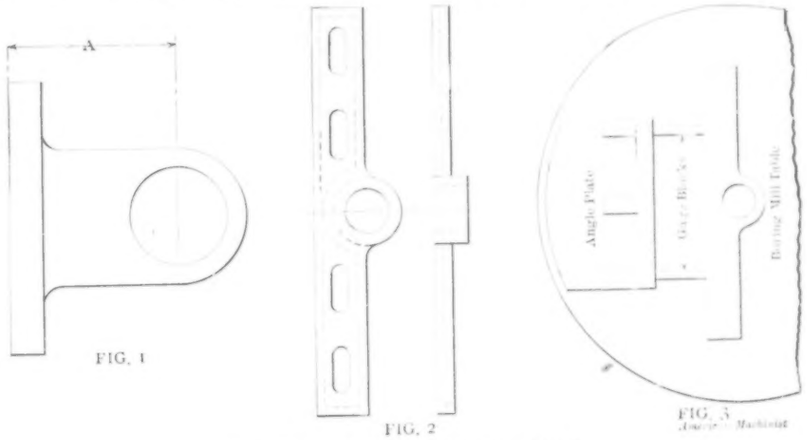
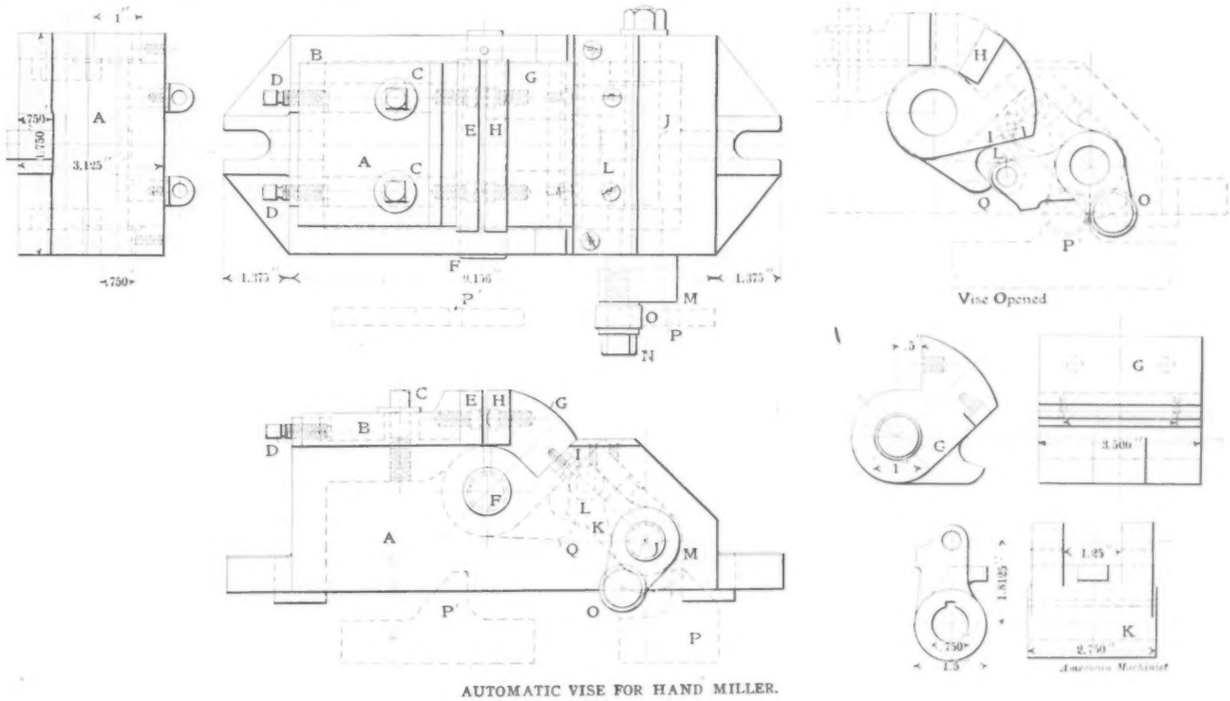


FIG. 1 FIG. 2 FIG. 3

SETTING ACCURATE BORING MILL WORK.



AUTOMATIC VISE FOR HAND MILLER.

set no one could rely on its coming out accurately, because setting to lines on close work is not good enough. Something positive is wanted, and to meet the requirements of this particular case the tool, Fig. 2, was made. This is a gray-iron casting; a straight-edge with a boss. The central hole in the mill table was first skimmed out true and the boss made to fit it. The next important operation was to make the edge of the straight-edge a given distance from the center of the boss. Fig. 3 shows the tool in use. Simply drop it in the table, and with block gages the length of *A* in Fig. 1, minus the distance of the edge to the boss center, set up the angle-plate and clamp down. Everything is now ready for the work, which may be relied upon, providing the angle-plate is true.

The use of this tool cut out a lot of "monkeying," besides reducing the trouble to a minimum, and it consequently filled the bill. J. PRICE.

Various Apprentice Experiences.

Reading over the several letters you have printed in the last year on the apprentice question, recalls vividly to my mind the days of my own apprenticeship, and the question arises in my mind whether it matters very much, after all, where or on what class of work an apprentice puts in those first three years of elementary study and labor? In any event, when he leaves his *Alma Mater* and goes into new shops, is he not placed at a disadvantage for a time more or less long, governed only by his ability to adapt himself to the new conditions surrounding him? Shop conditions and systems are never just alike, and what is close, fine work for one man would be described by another as rough.

I once sought a job in a mill repair shop, and when hired by the superintendent I was told that I would be paid their standard pay if it was found that I could do their work. The first work I received was finishing set collars for shafting, and in the year I worked there I saw very little work more close than turning gear blanks.

As an apprentice I worked in a shop making medium heavy machinery for textile finishing, and on that class of work 1-100 of an inch was considered close enough for much of the work, and some would pass if made within 1-64 of an inch. One of the neighboring shops was one of the largest tool shops in the country, where measurements were computed by thousandths of an inch, and while we apprentices were mildly curious concerning their shop methods, we always thoroughly despised the graduates of that shop. Probably this was because, in our limited experience, we had seen but few of them, the company, no doubt, retaining the best of them for their own service, while the "black sheep" were allowed to find new jobs. One noticeable mark of these graduates was their ability to criticise the quality of the work of our shop, coupled with their complete inability to drill holes in the right places or to bore and turn decent fits.

Several years afterward I worked in that same tool shop, assisting in the erection of milling machines, and to my surprise I found a noticeable difference in the quality of the work in the finished machines, as compared with the finished details. I had always, after my apprenticeship days, stood rather in awe of the shop itself, and revered it as a shop of standard sizes, and for that reason, perhaps, I expected greater accuracy than I should have looked for in another shop.

One of the first jobs I had was fitting the feed shafts and pulleys on a lot of twelve machines. The lower feed shaft was in the base of the machine, and the two-step cone pulley on its end was made interchangeable with the two-step cone on the stud above it, both cones fitting on gray-iron bushings. These step cones were nicely finished and, presumably, reamed, and the bushings were handsomely ground on the fit. When these were brought in on the truck I admired them greatly, and metaphorically I patted the shop on its back for its nicely finished details. Surely the life of an erector here was to be a sinecure. Imagine my feelings when, upon trial, not one of the cones would fit on any one of the nicely ground bushings. I reported the matter to the gang foreman, who "jawed" a little in Swedish and got me a file, telling me to drawfile them until they would fit and interchange. As there were several off-size holes in the lot, it took considerable "swapping" to get them paired off to suit.

Again, having some small collars to face up, I got from the toolroom a 1-inch arbor. The first collar slipped clear over, the second followed suit, and not one in the twelve was right. Back to the toolroom I went, and giving the attendant one of the collars, told him I wanted a 1-inch arbor that would fit *that* 1-inch hole. After trying four, he found one that would do, although I had to use paper in some of the holes even then.

These and other things opened my eyes to the fact that my idol was but common clay, and that the reamers and arbors in many small shops are kept much nearer standard than are those in some shops whose names are more widely known. I know from experience that the finished machines and tools turned out by this concern are up to standard in workmanship before they pass the inspector, and I cannot understand why they should allow such lax work upon details that could be better fitted with less expense at the first handling. Perhaps there are many points on handling details in large shops with which I am not familiar, but if anyone can show me how such practices as those described above can increase production, I would certainly be glad to hear from them. L. L. ARNOLD.

Practical Appreciation—Casting Teeth in Gears to be Cut.

When will bosses learn that to the majority of men a word of praise is as great an incentive to increased effort as a raise of wage, that a two-shilling raise made voluntarily is thought as much of as one of five shillings which has to be extracted, as it were, at the point of the bayonet? These remarks are suggested by my own experience. I was with one firm three years. When I had been there 18 months I asked the cashier if it wasn't time I had a raise, and he told me they wouldn't give me a raise without being asked, so of course I asked, and I got it. But why was it necessary for me to ask? The boss evidently thought I was worth a raise, else why should he give it to me, and if worth it why was I not given it without having to ask for it? I have never yet come across a chap who liked the job of asking for a raise, and yet how many firms does one find which voluntarily raise wages? I do not mean to say there are none, because I have worked for one myself, but the pity is that there are not more.

As I said before, I was with one firm three years and never during that time did I get one word of encouragement. I used to be given a machine to design something like this: "I say, Nemo, I wish you would get out a lathe for such and such work." (I may here say that we only built tools which were specially for ourselves, not for sale.) "I would like you to get on with it at once." As it happened, the manager and I were good friends and I would therefore know that this particular machine had been talked about for two or three months, and yet as soon as it was mentioned to me I was expected to start on it immediately. Perhaps I might wish for further particulars, such as whether the lathe was to be driven by belt or motor, and the answer I would get would probably be: "Oh! I don't know, I pay you for deciding that sort of thing. If there's anything else you want to know see Jones (the manager), but get something on paper and then I'll come and look at it." I would accordingly start off and perhaps would get the whole thing designed in a certain style, when in would come the boss: "Oh, I say, Nemo, I was at Blank's yesterday. I saw a Champion lathe. I wish you would make this something like it. It had so and so," naming several special features. I would point out that a lathe of that type was entirely unsuited for the work we required ours for, and then he would come out with one of his stock phrases, something like this: "I wish you would read that article in this week's

AMERICAN MACHINIST on draftsmen; it fits you down to the ground. You chaps get a bit of a drawing made and then bow down and worship it, and won't or can't see anything wrong in it." I would then have to try to convince him that it was to my interest to make the best design in my power to do the work required, and minutely explain why I thought my design the best. Sometimes I would succeed and sometimes not. In either case he would go away in a huff, after saying he "couldn't see the idea" of paying a draftsman and then having to settle every little point in the design himself. After the machine was built he would get all the foremen around him and hold a conversatione to see if they could improve on it at all. I may say that I make it a rule to always consult the foreman who is likely to have the use of the machine, to settle general principles, but in questions of design I always follow my own ideas, if I think they are the best. If the boss or any of the foremen thought there was something not quite right, even if it were only a cheese-headed screw in place of a countersunk, the boss would labor the point for weeks.

At the time I asked him for a raise he said: "You know, Nemo, you're getting some good experience here." I agreed with him, but I pointed out that experience was poor stuff to make a dinner of. After putting up with this sort of thing for three years I got another job; then I was told they would have given me anything I liked in reason to stay, and in fact they said all the nice things about me which I should have been very pleased to have heard under other circumstances; but it was a case of "once bitten twice shy," so I cleared out. This is the sort of thing which occurs in too many English shops. I understand it is different in America. I hope it is. There are horses which can be coaxed when they won't go for whipping, and most men are the same. If kind words cost dollars, I suppose more use would be made of them and their value would be more appreciated.

While I am writing to you I should like to ask Mr. Holley why he cast the teeth in his gears (page 593). I should have thought the advantage in a 1-inch pitch gear would not compensate for the risk of having the stock come all one-sided when he got to the last few teeth. I have seen this occur with gears of less than 12-inch face. Of course this is obviated by careful work, but this would cost as much as cutting in the solid. In addition I have found that the crust of the metal dulls the cutters very quickly, so that except in the case of gears of large pitch, where it would be necessary to go around with a stocking cutter, perhaps twice, it is not worth while to cast teeth in. NEMO.

London.

Auto-Truck Tools.

I send herewith a description of a few tools made at a shop building auto trucks.

The steering head Fig. 1 was originally first centered, then turned on centers and afterward laid out and set up in V-blocks on the drill press, where holes *a* and *b* were drilled and reamed. In order to relieve the pressure at the engine lathe a drill jig and turret-lathe fixture were designed. The drill jig was a simple affair in which the two holes were drilled and reamed and the bosses faced at one side. Then the work was removed from the jig and the other side faced, ready for the turning operation in the fixture

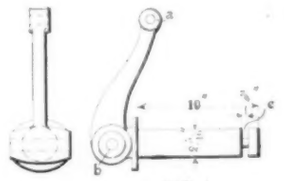
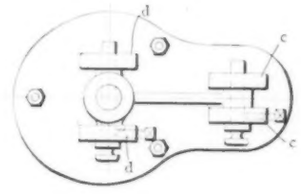


FIG. 1



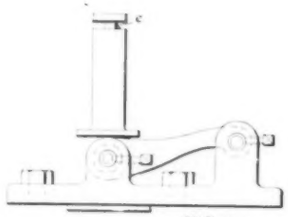


FIG. 2.

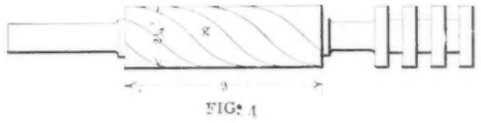


FIG. 4

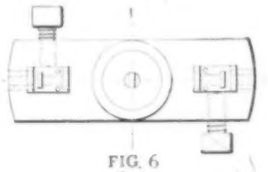
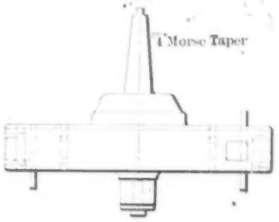


FIG. 6



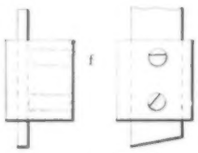


FIG. 3

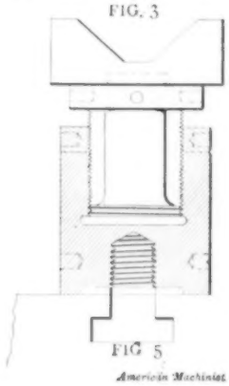


FIG. 5

American Machinist

AUTO-TRUCK TOOLS.

Fig. 2, which was used on an American turret lathe.

This fixture had a hub fitting a shallow counterbore in the face-plate and was bolted in place. It was accurately bored to correspond to the spacing of the holes in the drill jig, and the work was held in position between the standards *c* and *d* by two plugs. Upon one side of the turret were fastened by heavy fillister-head screws two solid steel tool blocks (made from scrap removed from crankshaft webs) which were placed diametrically opposite and which carried the roughing tools. Upon the following side were two similar blocks for the finishing tools and a third face carried a tool for facing the shoulder and forming the fillet. As the cut ran up, the end of the work entered and passed through the hole in the center of the turret face, thus allowing the tool blocks to be quite short and with very little overhang. The groove *e* was formed by a tool in the cross-slide post and for this operation a special back rest was provided.

Fig. 3 shows a tool which was made to cut some 8½-inch holes in ⅜-inch thick boiler-plate—the material used for sides of wheels in some heavy, mining auto cars. The pilot hole was first drilled, after which the boring tool was placed in the drill spindle and fed through. It will be noted that the cutters (3-16x¾-inch Novo steel) were held in blocks as shown at *f*, the blocks being adjustable for size of hole.

A very important feature in the working of this tool was the tracking of the tools, they being so set that one cutter cut at its outside corner, acting in the nature of a boring tool, while the other cutter did the cutting at its inside corner, as a turning tool, removing stock from the core. In this way the tools were kept from clogging, as they worked in a groove wider than their cutting face.

There was used in each truck a steering

worm Fig. 4, the part *g* being cut a double, right-hand, Acme thread of 1½-inch lead. The best time ever attained upon an engine lathe cutting the worm was three-quarters of an hour, roughing out with a square-nose tool, and one hour for finishing each worm. In developing the mechanism it was found desirable to use a worm of 3 inches lead, quadruple thread, and the first one was accordingly cut upon a lathe, requiring about 25 hours for its completion. This time not being satisfactory we were given the job in the toolroom to try upon the milling machine, as the nut was to be babbitted upon the worm, it was not necessary for the thread to be of the exact Acme form, so that we selected a 6 P. No. 2 gear-cutter and obtained a close approximation to the thread desired.

The first one consumed about six hours, and after experimenting with speeds and feeds the time was so reduced that the second lot of 12 were completed at the rate of one hour and twenty minutes each.

FIG. 1

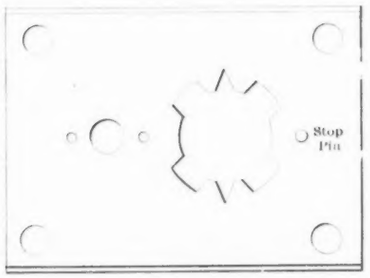


FIG. 2

The adjustable, swiveling V-block shown at Fig. 5 was made for use with this job and proved very satisfactory.

RAYMOND GRANT.

Soap Under the Dirt—with Vaseline Added.

Do not scoff at a little simple "improvement" like soaping your hands before tackling a dirty job, as suggested at page 734. Those who have tried it, using a pure castile soap have come nearer to godliness (if that is next to cleanliness) than those who have not. Once I suffered with dirty hands, which "all Neptune's ocean" might not have cleansed, during some experiments with earthy and alkaline material. I thought I was the original inventor of the "before taking" soap treatment, and when I had learned to mix vaseline with a pure mild soap before getting into the dirt I was able to make myself fit to be seen after cleaning up, and with no damage to the cuticle.

C. W.

[Our apologies are due to the writer of the letter to which C. W. refers. The editorial item attached to it was put there in violation of a repeatedly stated rule of the office, which prohibits the publication of a communication offered in good faith and at the same time attaching to it editorial comment tending to discredit it. It is a discourtesy to a contributor which we do not intend to be guilty of, and which we shall take renewed pains to avoid in the future.—ED.]

Piercing, Blanking and Bending Dies.

I was a new man in a small jobbing punch and die shop, and for the first two days my work was rather simple, giving me an opportunity to size up the shop and its facilities. On the morning of the third day the foreman, who was also the owner, inquired if I would enjoy the prospect of working on a set of dies in which there would be no profit. He then explained that he had a large customer (large in orders if not in heart), in the curtain business, who had again demanded a lower figure, which in view of a large quantity of stock on hand he was compelled to accede to.

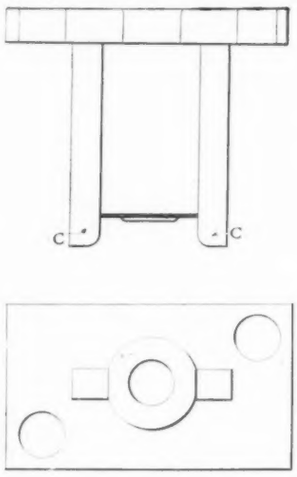


FIG. 3

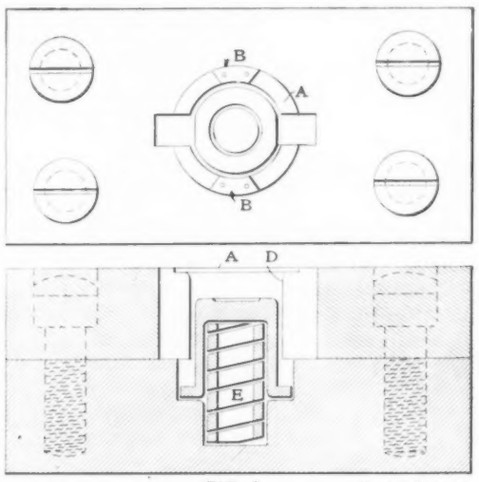


FIG. 4

American Machinist

PIERCING, BLANKING AND BENDING DIES.

The dies—blanking, piercing, forming and bending—occupied a power press and a number of foot presses, performing at separate operations what I conceived might be accomplished in one die, the finished article being like Fig. 1, with four lugs drawn on one side and two points at the other, with a slight depression in the center, like a countersink. On an intimation from me that more expensive tools might save money, he took me to the steel pile alongside the hacksaw machine and told me to make the necessary dies as the old ones were worn out.

And that was a steel pile worth having; the die stock varying in width by half inches, and being of a "special" annealed stock, so soft that it could be machined very rapidly, yet it never refused to respond to a low heat and quenching in a tepid bath.

The blanking and piercing operations, as is usually the case, were kept in a follow die by themselves, as shown in plan in Fig. 2. The three small holes at the left-hand or piercing end of the die are located so that at the next position of the stock they will be exactly central over the blanking die, permitting a pilot pin in the center of the blanking punch (not shown) to enter the center hole of the punching.

The combination bending, drawing and stamping punch and die to finish the work at one operation were made as in Figs. 3 and 4. The blank was inserted in a slight recess *A*, fitted with two gage plates *B*, to insure the correct position of the piece.

The extended lugs *C* on the punch first bent the sharp points of the blank down over a rather stiff spring ejector in the center of die. Continuing in the downward stroke the circular body of the punch forces the blank into the round portion *D* of the die, which is twice the thickness of the blank larger than the punch and has slightly rounded edges, thus bending the four lugs to the opposite side of the blank from the points, and drawing them into cylindrical shape, and, finally, when the spring ejector has bottomed, embossing a depression in the center of the blank, corresponding to the countersink in the top of the ejector. On the withdrawal of the punch, the blank is thrown out of the die by a stiff spring *E*, which I prefer to rubber, as I consider it much longer lived.

As the space for the spring was limited, I decided to use an idea I had seen in the AMERICAN MACHINIST. Catching a piece of drill rod, of the proper size to fill the ejector, in the lathe chuck, I cut a square thread the proper pitch to give ⅛-inch stock in the spring, removed the stock from the center of the spring with a small drill, and then a counterbore, finally cutting it off to the proper length and hardening in oil.

The boys were delighted to be relieved

from making these pieces on the foot-press, and when the curtain manufacturer found out there was something doing, he soon ordered other sizes and thicker metal, which it had been impossible to get before, so there must have been some profit in it. BURNBRAY.

Doing Worthless Work to Order.

Mr. Alton at page 592 asks "what is the right thing to do?" It's a hard question to answer; one that no man could correctly reply to without knowing both sides.

Shortly after I started in business, Mr. Wheels came in one day and asked me if I could make an "automatic motor," the design for which he had at that moment in his brain (?). I told him that as I was merely a machinist and not a mind reader, a little sketch, showing the principles of the machine might help me to decide whether I could or could not make it.

He made a sketch then and there—on the back of an envelope—of what I recognized as a very old form of perpetual motion.

"It won't work," said I. "I did not ask you that, I want to know if you will make it according to instructions. If you won't I guess there is someone in town who will, and without offering any uncalled for comments too." What was I to do? Here was a man with work he wanted done, and money to pay for it. I was without work, and possessed of a bank account consisting of an overdraft of twelve dollars and thirty-four cents, "which please call and settle at once."

I took that job, got fifty dollars down, and arranged to be paid weekly as the work progressed. The machine was the shape of an isosceles triangle, in such position that the base was vertical. Around the outside was arranged a track upon which five weights were disposed at regular intervals. They were held in position by two chains which ran on sprockets mounted at the angles. Four weights going down the angles were supposed to lift one weight vertically. All the bearings were equipped with either balls or rollers, and the chains had 9 rollers around each stud. In all there were about 10,000 rollers in the machine.

Eventually it was nearly completed and so well was the work done that the machine—without the heavy weights—could be run with a piece of No. 60 spool cotton. The day before the job was finished Mr. Wheels came in. "Well, Mr. Dixie, when will she be ready?" "Tomorrow at noon," I replied. "Well, don't start her till I come; I want to have the honor of starting the machine that is to revolutionize the source of power for the whole world." So the next morning, after the weights were in place, I moved them to the position farthest from equilibrium, and stuck a bar of wood in the spokes of one of the sprockets. I then tied some rope around the chains in various places, this for two reasons. In the first place Mr. Wheels had paid so much that he was entitled to a little extra style and further a matter of self-preservation and duty to my family demanded that I should have warning so that I could save myself, should the automatic motor take it into its head to start. This warning the breaking ropes would give.

Promptly at noon Mr. Wheels came in bubbling over with the anticipation of success. He untied the ropes and pulled out the wooden bar. Away went the weights down the incline, then stopped and wagged to and fro in a helpless, aimless sort of way, finally coming to a dead stop. "What do you think of that, Dixie?"

"Just what I told you at first; it won't work."

"Won't work? Now don't be a d—d fool, all we need is a flywheel." So a flywheel was obtained and put on, and then a heavier one, and finally Mr. Wheels seemed to be losing his confidence and sat down—with a wild look in his eyes—to ponder. I had never seen him in such a mood before, and thought, poor devil, he's going "nutty"; and as a matter of precaution I backed over to the bench and got my hand—in an unostentatious manner—on the handle of a two-pound hammer. At last, with a burst of the craziest laughter I ever heard, he sprang up and ran toward me. My strength left me, and I could hardly stand. Grabbing me by the shoulder as the hammer slid from my nerveless fingers, he fairly shouted, "Dixie I've been a d—d fool." I nodded weakly in assent. "We've built it wrong end first. It must be taken apart and rebuilt. It will run the other way all right."

I tried to persuade him that it was not necessary to rebuild it, that if it would run the other way—*i.e.* in the opposite direction—it would do so without rebuilding; but to no purpose. I had to take it apart and rebuild it, with the same result in the end. The last time I saw Mr. Wheels, he told me that he still believed the thing feasible, but could not afford to spend any more money on it. He, however, made this liberal proposal to me. If *I* would go ahead and finish the machine and produce a working model, *he* would form a company capitalized at ten millions *and give me fifty thousand dollars worth of stock*. (The stock of that company is non-accessible.)

Another man came in one day and asked me if I could make a perfect sphere. I said I could make a sphere so true that he would not be able to detect any error. (I arrived at this conclusion in quite a shrewd Sherlock Holmes way, for when he asked the question he drew a five-cent boxwood rule from his pocket and specified the diameter as "about four inches within an eighth or so either way"). He then asked me if I could put a spherical hole in it exactly in the center. I told him I could, providing he would let me make the affair in two parts. That, he said, would not do. On being questioned further by me—so that I might find a way to help him out—as to what the article was for, he shut up like a clam after telling me it was none of my business.

In that same town was a foundryman, a practical joker, who had worked off some of his jokes on me. Now, I thought, is mine enemy delivered into my hand. Selah! We will call him Jones because it's not his name. I assured the ball fiend that I was not at all interested in his device beyond a desire to assist him to get it made. I said that from what he had already told me of it, I was certain there was but one man in the country, and possibly in the world who could help him. I explained to him that Jones was a very peculiar man, one who resented having anything out of the ordinary sprung on him suddenly. I said, "The best way for you to tackle Jones is to just go 'round and see him, and then talk about anything rather than this ball business, spin it out as long as possible, talk of the weather, the crops, the latest inventions in flying machines and any old thing that may occur to you, but don't mention the sphere at all till he *appears* to get surly and asks you what the h—l you are wasting his time for. Then you can tell him about the ball. Now another of Jones' peculiarities is, that although he is a man of vast knowledge in the foundry business, he is extremely diffident. Being a genius, he has a peculiar way of showing his modesty. He will start to rip around and curse like a pirate, but that's only his way. During the time he is carrying on like a maniac his active brain is working out a way to help you. He will probably finish up by telling you what he always tells me (this was true)—to get to h—l out of there with your idiotic idea. That will be your cue. Ask him if he can make a spherical mold the same as he made for the Keeley motor sphere, or the grape-shot during the Civil War, then tell him instead of a sand core, to use a . . . and anchor it absolutely central. If he attempts to turn the idea down, tell him *I* told you about it and sent you to him to have it executed."

My customer left with expressions of deep and lasting gratitude, to tackle Jones.

Now Jones did have one other peculiarity besides his love of practical jokes and that was he imagined he was always busy. To get him to talk for ten minutes, except on the subject of practical jokes—of his own—was out of the question.

Two hours after my customer had gone a boy came over from the drug store at the corner. "Mr. Dixie, Mr. Jones wants you on the 'phone, at least the boss thinks

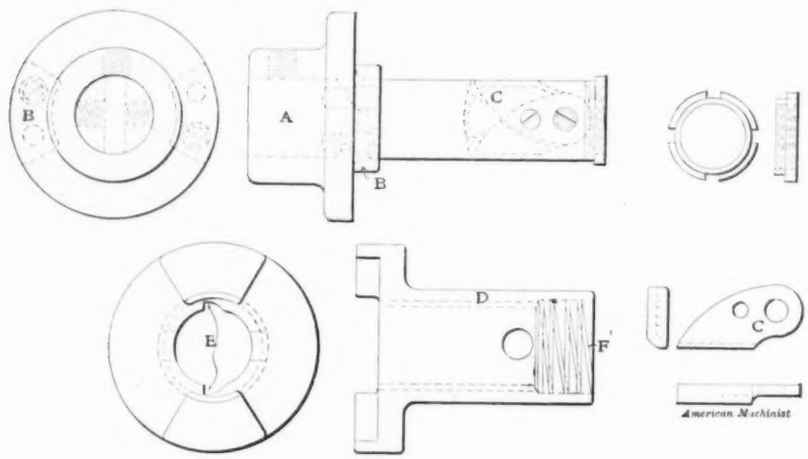
it's you. Mr. Jones is that mad, he can't do nothin' but sputter and cuss." When I got the receiver to my ear, I heard, "That you, Dixie, —— —— you, I'll get square with you, sendin' a —— fool 'round here wastin' an hour and a half of my vallyble time, chinnin' about every subject under the sun and then windin' up by tellin' me he wanted *me*—that's been in the foundry business fifty years—to blow soap-bubbles and cast iron 'round 'em. By ——, I kicked him out of the foundry and you'll get the same, —— you, if you ever show your ugly face in here again."

DIXIE.

Tap and Die Holder.

The sketches show a reversing tap or die holder of rather a useful type. The holder proper, *A*, has segment pieces *B* attached to it by a screw and dowel pin each; these segment pieces are made 60 degree included angle. The shank is slotted for two small tongues *C*, which are held together by a small stud. These tongues are held as required from moving by two small screws, one of which must always be tightened so as to allow the other to be moved by the spring. Piece *D* is the main body and has segments corresponding to those on *A*, only machined out of the solid; it has also two parallel keyways *E*, and is recessed at the back to take the spring *F*. A hole is drilled also through the shank, so that either one of the tongues can be placed into action; the holder is thus adjustable for either right- or left-hand threading. The action of the holder is easily seen. When it is released from the segments it revolves until the reverse speed is thrown on and then the tongue is thrown into the slot and backs the tap or die out. The spring on the end should be just strong enough to bring the holder back again, so that it may be used on an automatic machine and save time. This type of holder has been used with much success and seldom requires repairing.

NOMAD.



TAP AND DIE HOLDER.

A Fixture for Sawing out Brass Blanks.

Fig. 1 shows a fixture for cutting out the brass piece drawn to larger scale in Fig. 2. This piece has four holes drilled equi-distant, near the edge, the holes being drilled in a jig to a stop within 1-16 inch of the other side; a smaller hole is then drilled through this 1-16 bottom. In the center is another hole ¼ inch in diameter and reamed clear through. The dotted lines in the plan show where the two saws travel; the four segments *A* are scrapped.

The fixture has a gray-iron base, with a tongue (not shown) inserted in the bottom; all pieces aside from this base are tool steel. *B* is a tail-block, in which is a movable hardened center with a strong coil spring behind it. The center is restricted in its travel by the stud *C* and actuated by the pivoted hand-lever *D*.

The headstock *E* has a top made in one piece with the center. The arbor *F* is turned to receive the retaining thimble *G* and the clamp-nut *H*. The head of *F* is milled away, leaving an equally spaced, four-pronged spider. Now, in each arm of this spider is permanently inserted a pin *K*, and the end of each pin, where it projects into the thimble *G*, is turned down to fit the small holes in the brass piece, Fig. 2. The pins thus hold the work in a rigid position between the clamping thimble *G* and head *F* while the pieces *L* are milled out.

The block *M* carries an index pin with a nurled head, which is milled away, as shown, to fit the elongated hole in the block. A spring normally holds the pin against the spider *F*, but by pulling the nurled head outward, and giving it a quarter turn, the pin is held back out of the way. This pin locks the wings of the spider *F* and holds the affair rigidly while the cutters are doing the milling. It will be seen that to get four finished pieces like *L* it is necessary for the blank to be indexed four times.

CARROLL ASHLEY.

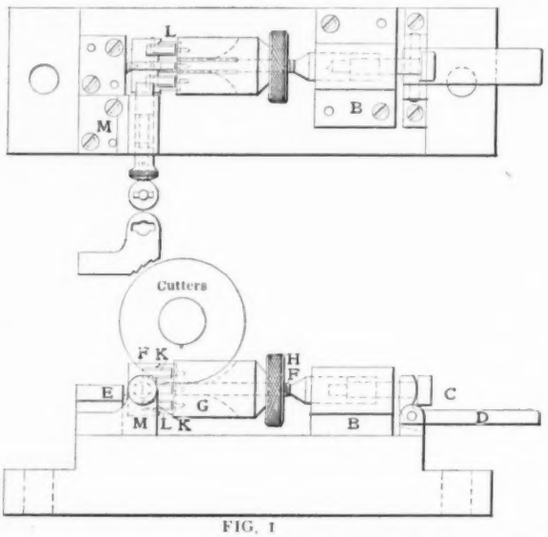


FIG. 1

FIXTURE FOR SAWING BRASS BLOCKS.

FIG. 2

Liquid Glass in the Foundry.

The following is the substance of a letter written in reply to a personal inquiry. It occurs to me that there are others who would or should be glad to know what they can about the use of liquid glass in the foundry, of which I have had some experience.

Liquid glass is of a very light straw color, although I have seen it darker, and is of a thick, syrupy nature. It should be kept tightly stoppered in the bottle, as it quickly hardens if exposed to the air. In handling the bottle it is kept in, look out that there is none sticking on the outside that has hardened, as it is like glass, and any of it forming a point will quickly cut the fingers.

I have used it on wrought iron and steel, also on shafts which were to have molten metal poured around them in molds. Our way of using it was as follows:

It was kept in a jar or bottle, with a

neck large enough so that a brush could be dipped into it. A molder would warm the shaft enough in the winter time to take out any frost and let it get blood-warm. In the summer time we did not warm the shafts or spokes. He then dipped the brush in the bottle, and painted the shaft, or the ends of the spokes where the molten metal was to run around them. If the shafts are too warm, the liquid glass will roll and not cover easily; if the shafts are oily it will do the same. The shafts were ground off where the iron was to cover them to remove any rust. Where they were black, as caused by forging, they were slightly ground, although we have taken rolled shafting as it came to the shop and given it a coat of liquid glass, and have found that the iron lay to it all right. But in the case referred to, the wheel rims were turned and polished, and were required to be sound and clean. The brush, after using, was washed out with hot water. If this was not done, it would harden up so that it would be useless, and I never could start it out afterwards even with quite hot water; I don't know what boiling water would do.

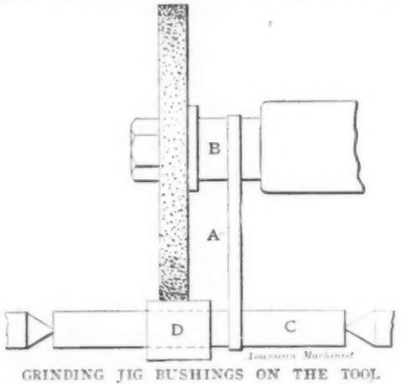
I have been told that a shaft, given a coating of the liquid glass, could have brass cast on to it easily, but have never tried it; also that if a cylinder mold is sprayed with it and cast on end, any dirt collecting in the mold around the sides will not be caught against the sides of cores or mold, but will keep rising to the surface of the molten metal, as the preparation keeps melting off as the mold fills, and will pass up into a shrink-head prepared to receive it.

Liquid glass is known to the drug trade as *Liq. Sodii Silicatis*, can be obtained of any wholesale drug store, and is by no means expensive.

Warren, Mass. R. H. PALMER.

Grinding Jig Bushings on the Tool Grinder.

Heretofore all the jig bushings to be ground were taken from the toolroom to



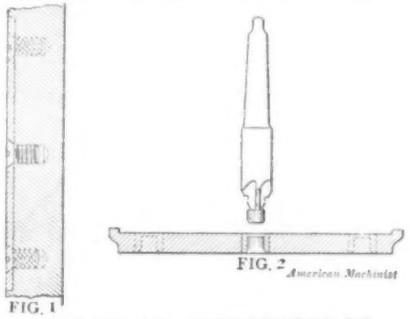
GRINDING JIG BUSHINGS ON THE TOOL GRINDER.

the grinding department, and there waited until one of the machines was vacant, to be finished, until one of the toolmakers hit upon the scheme of grinding them on the tool grinder, as shown in the sketch, with very satisfactory results.

Rubber band *A* is put over spindle *B* and mandrel *C*, holding bushing *D* to be ground. Although the bushing runs at a very high speed a fine finish and great accuracy are obtained. It is obvious that the belt must be of some elastic material, so as not to become slack in feeding up the work. In this instance the workman cut up several worn-out tires for bands, though doubtless any rubber band would answer as well. L. F. B.

A Drilling and Countersinking Jig.

In Fig. 1 is shown in section a bronze plate (about 7x10 inches) fitted to a recess in a gray-iron slide and held in



A DRILLING AND COUNTERSINKING JIG.

place by five screws. The parts must interchange, and the plates are made in quantities to be sent out to replace those worn out. A section of the jig for these plates is shown in Fig. 2. The jig is recessed on one side for the plate and exactly opposite has a projection to fit the gray-iron part; there it acts as a gage for both parts. The bushings are the right size for the tap drill for the gray-iron part, and the same drill is put through the bronze plate. The plates and jig are then turned over and the countersink used, the pilot bushing on the countersink being made to fit the jig bushings.

ISAAC MORGAN.

Fountain Drawing Pens—New Inks Wanted.

I agree with your correspondent E. B. E. at page 736, in his article, "A Chance for the Inventor," that there is a chance, but I think a very poor one for some of the items mentioned. For instance, he proposes a fountain pen for tracing, the design of which is quite feasible, but he does not say anything about the ink which could be used for such a pen. A tracer knows quite well that the greatest nuisance he has to contend with is the keeping of his pen continually clean so as to insure the easy running of the ink and to obtain a clear black line. Hence appears the difficulty, the ink necessarily being so thick, to be certain of obtaining good prints, that it dries very quickly.

It is a well known fact that the thicker the ink the quicker it is in drying. A fountain pen very often is clogged when using thin writing ink. Therefore the first thing to invent is an ink which is as dense as India ink, but a slow drier. Such an ink has up to now baffled all inventors, and seems likely to do so for a little while longer, therefore the idea of a fountain for tracers has to be abandoned, at least for a little while.

The same thing applies to the indorsing ink for rubber stamps which are sometimes used for putting the address of the firm on the tracing. With the ordinary indorsing ink the stamp is only just perceptible on white prints and is only a little better on blue ones. There are a few inks on the market which are guaranteed to show on prints, but the ink being so thick it very quickly dries, clogging the stamp so that it has to be cleaned very often, thus wasting the time saved by not having to re-stamp the prints, which operation is required when ordinary indorsing ink is used.

Also the typewriter your correspondent mentions: The ink which would clog the fountain pen would clog the letters and dry too quickly on the ribbon.

Thus it is self-evident that the ink is the item which should engage most attention, unless a special kind of tracing cloth or printing paper could be manufactured which would allow of good prints being made when using a thinner kind of ink.

There is no doubt that dotting pens are a nuisance and I can only see one way in which they could be improved upon, and that is by arranging the pen so that the circular nib would receive the ink and that the thickness of the dotted line made by it could be regulated by a screen similar to the one used on the ordinary drawing pen.

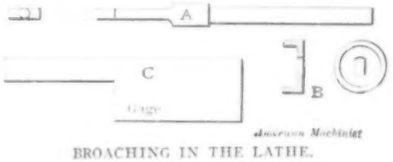
Since writing the above I notice that a fountain pen for draftsmen is described at page 779 in your article on new tools and machine shop appliances, and while admitting that it is a great improvement on the old style of fountain pen I still maintain that the ink would choke or clog, but perhaps not so badly as with the ordinary type.

My reason for this is, that whenever India ink is used there is always some insoluble substance left after drying, which is added to with each successive process of drying until it has increased to such an extent that it causes clogging.

TROCHEE.

Broaching in the Lathe.

It was required not long ago to make a few hundred brass pieces the same as shown at *B* in the drawing. In the center of the pieces were quasi-rectangular holes,



BROACHING IN THE LATHE.

the short sides being round. We did not stamp them, as the quantity did not warrant the expense of making dies. We took an 18-inch engine lathe, with hollow spindle, to do this work. In the tailstock we placed an Almond turret tool-holder. The stock was drilled and bored with a flat drill. The rectangular holes in the pieces were ⅛x3-16, consequently the small end of the flat drill was ⅛ inch. When this was done we stopped the lathe and put the broach *A* through the hole, using the tail spindle to force it through. *C* is a gage that we used for setting out the stock. The pieces were cut off by the cross-feed, the carriage being fixed.

L. I. ROSENTHAL.

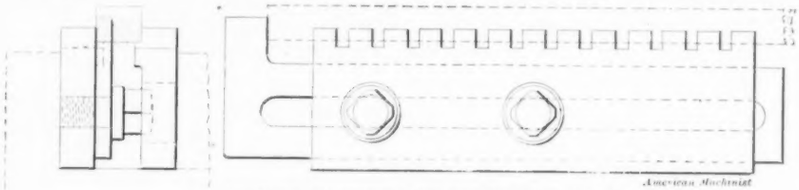
Table of Dimensions of Seamless Steel Tubing.

I enclose a blueprint of our drawing, No. 129, showing the inside diameter, outside diameter and thickness of wall in B. W. G. gage and decimals of an inch of seamless steel tubing. I have not been able to find this table in any of the handbooks. I find it of considerable use to me, and think it may prove of general interest to your readers.

THE SWITCHBOARD EQUIPMENT COMPANY,
C. C. BADEAU, Chief Engineer.
Pittsburg, Pa.

Milling-Machine Vise Jaws.

The vise jaws here shown are a very useful addition to a milling outfit. Where it is required to cut a number of pieces to exactly the same lengths, they are very effective. The jaws are shown in position holding square stock, but round stock can be held just as readily. The sliding stop is easily set, and can be fastened solidly up to the under side of the ledge provided on the front jaw. The stop should hug closely up to this ledge when clamped, thus doing away with the tendency to give down should the stock be pushed against it with unnecessary force. The slots across the tops of the jaws are clearance spaces for the saw to pass through, and can be made as many or as few as desired. The right-hand stop clamp-screw can be removed entirely and the stop then slid over to the left to the end of the slot, thus greatly increasing the length that can be cut. These jaws are in daily use where I am employed, and are giving great satisfaction.



MILLING MACHINE VISE JAWS FOR CUTTING OFF STOCK TO LENGTH.

H. G. B.

Reamers With Staggered Teeth.

Some years ago we were building a line of machines which required more scraping and fitting than was good for the proprietor's bank account.

Fig. 1 shows where a good deal of the scraping was done. In order to overcome it we made reamers with staggered teeth like Fig. 2, the cut of one tooth overlapping that of the next. These reamers were made of machine steel with drill rod teeth driven in. When worn below size the teeth were knocked out and a piece of tin was put in behind each tooth and the reamer ground to size. Instead of feeding the reamer through, we put it in place and gradually tightened the boxes *A A*, Fig. 1, down on top of it, while it was being turned. For reaming *B*, Fig. 1, we made a reamer with ground journals to fit *A A*, and tightened the cap of *B* down on the teeth while the reamer was being turned.

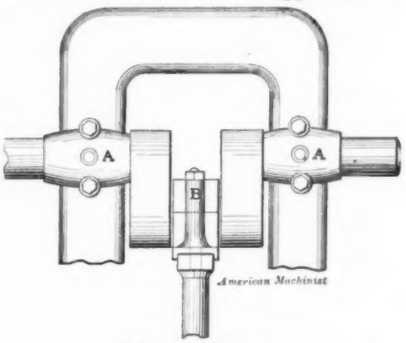


FIG. 1. THE JOB.

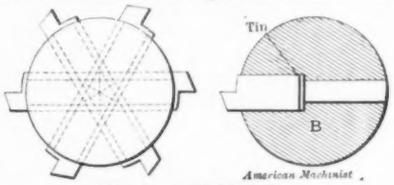


FIG. 2. THE REAMER.

F. J. K.

129 SE TITLE Inside Dia. Seamless Steel Tubing THE SWITCHBOARD EQUIPMENT CO. LEWIS BUILDING. PITTSBURGH, PA. 20 June '05. No. 129

No.	DESCRIPTION	DR OR PAT. NO.	MATERIAL		C	B	A	No.
1								1
2								2
3								3
4								4
5								5
6								6

Thickness of wall. Bⁿᵍ or Stubbs Wire Gauge. Decimal Equivalents. Outside Diameter

			⅜"	½"	⅝"	¾"	⅞"	1"	1⅛"	1¼"	1⅜"	1½"	1¾"	2"
23	025	.325	.450	.575	.700	.825	.950	1.075	1.200					
22	028	.319	.444	.569	.694	.819	.944	1.069	1.199	1.319				
21	032	.311	.436	.561	.686	.811	.936	1.061	1.186	1.311	1.436			
20	035	.305	.430	.555	.680	.805	.930	1.055	1.180	1.305	1.430	1.680	1.930	
19	042	.291	.416	.541	.666	.791	.916	1.041	1.166	1.291	1.416	1.666	1.916	
18	049	.277	.402	.527	.652	.777	.902	1.027	1.152	1.277	1.402	1.652	1.902	
17	058	.259	.384	.509	.634	.759	.884	1.009	1.134	1.259	1.384	1.634	1.884	
16	065	.245	.370	.495	.620	.795	.870	.995	1.120	1.245	1.370	1.620	1.870	
15	072	.231	.356	.481	.606	.731	.856	.981	1.106	1.231	1.356	1.606	1.856	
14	085				.584	.709	.834	.959	1.084	1.209	1.334	1.584	1.834	
13	095				.560	.685	.810	.935	1.060	1.185	1.310	1.560	1.810	
12	109				.532	.657	.782	.907	1.032	1.157	1.282	1.532	1.782	
11	120				.590	.635	.760	.885	1.010	1.135	1.260	1.510	1.760	
10	134				.482	.607	.732	.857	.982	1.107	1.232	1.482	1.732	
9	148				.454	.577	.704	.829	.954	1.079	1.204	1.454	1.704	
8	165				.420	.545	.670	.795	.920	1.095	1.170	1.420	1.670	
7	180				.390	.515	.640	.765	.890	1.075	1.140	1.390	1.640	
6	203						.594	.719	.844	.969	1.094	1.349	1.594	
¼	25						.500	.625	.750	.875	1.	1.250	1.5	
5/16	.3125								.625	.750	.875	1.125	1.370	
⅜	375									.625	.750	1.	1.25	
7/16	.4375										.625	.875	1.125	
½	5										5	.75	1.	

U • K Comment Hocy Badeau

129 129

TABLE OF SEAMLESS TUBE DIMENSIONS.

Studies in Inventive Problems—IX.

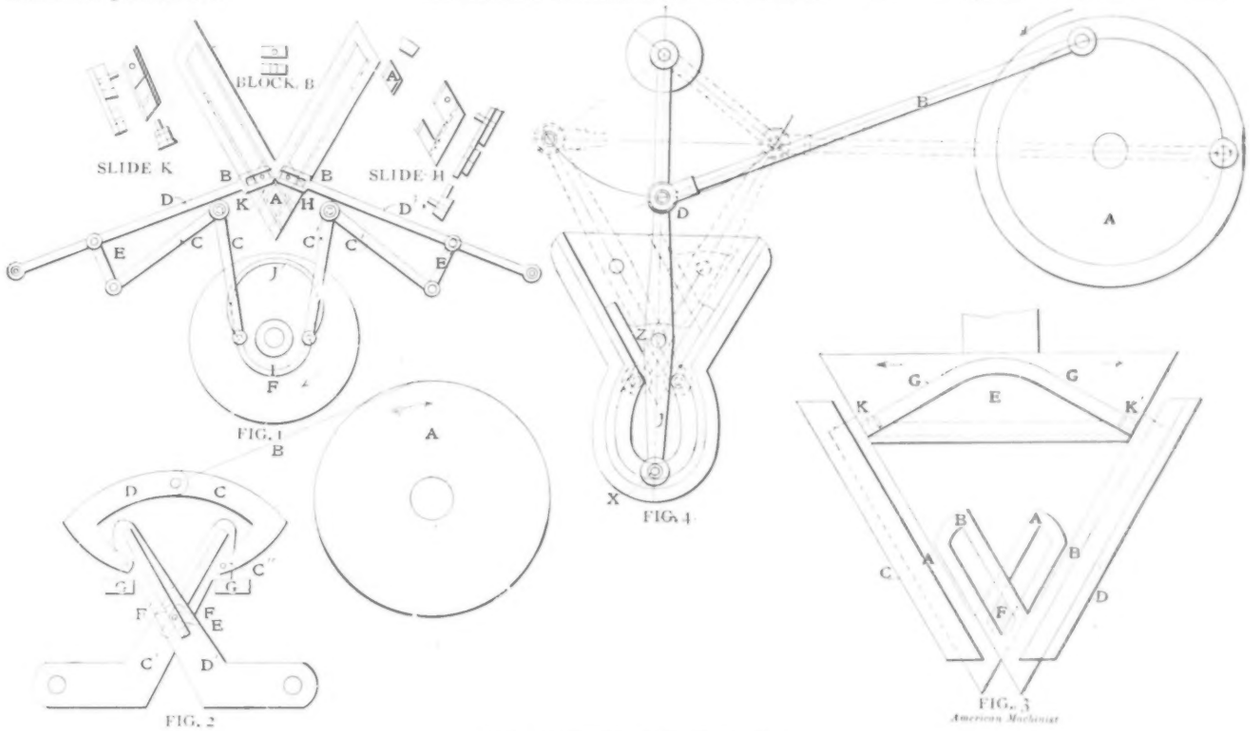
Proposed by Leicester Allen, and Solved by Various Readers.

The four solutions of Problem II herewith presented came to hand after the seventh article of the series, including my own solution, was prepared for the press. They conclude the solutions of the problem which I considered entitled to acceptance. J. Melancon, of Amite, La., in a recent letter criticizes me as being too liberal in my acceptance of Solution No. 10, because in the enunciation of the problem, spur gears, except such as needed to turn the driving wheel, are prohibited. The justice of this criticism is acknowledged. In considering the solution in question I myself overlooked the restriction pointed out.

PROBLEM II, SOLUTION NO. 27, FIG. 1. F. W. BACH, ILION, N. Y.

"Block *A* is the block to be moved and it fits in both of the slides in the position shown. The cam disk *F* moves in the direction of the arrow, the cam groove *J*, connected with bell crank *C'* by a roller and pin, produces the upward motion of the connecting rod *E'* swinging the third-class lever *D'* upward, and through sliding block *B'* and the pin in slide *H*, it causes *A* to travel up the right-hand branch of its path, and down to the dead point while the cam groove *I* holds bell crank *C* and connections at rest. Then, at the end of the first half revolution of *F* the block *A* and *D'* from moving outward from the position shown. When the rod *B* moves to the right, it rocks the link *C* over on its center *C''*, causing link *D* to pull lever *D'* and force block *F* (shown in dotted lines) up the slot in lever *C'*. On the return of *B*, it moves *D'* back into the position shown and then *D* rocks over to the left and pulls lever *C'*, forcing *F'* up the slot in *D'*. The rod *B* has now arrived at the limit of its movement to the left, and its further movement brings all the parts into the position shown in the drawing, after which the series of motions above described is repeated. The lever *D'* has two slotted arms which work one on each side of *C'*, though only one is shown in the drawing."

While accepting this solution as meeting the stated requirements of the problem, I think it would generate objectionable friction if much resistance were opposed to the movement of *F* and *F'*. This objectionable feature is avoided in solution 30, Fig. 3, wherein a much more direct application of the moving force to the sliding block *F* is attained. A strong movement can be secured on the lines indicated in this solution.



FINAL SOLUTIONS OF PROBLEM II.

Mr. Melancon further writes:

"In Solution No. 7 of Problem II, I doubt very much whether the mechanism provided for changing the motion of the block from one slot to the other would work as intended. If there should exist the least space or 'lost motion' between S_2 in the position shown and the back of the block, the block would be more apt, on account of the pressure exerted upon it by the spring T_2, to start backward over that branch of the path just traversed than to take the other branch. It seems to me that even with a perfect fit this tendency would exist in a small degree."

Having invited criticism, I present these remarks, without fully agreeing with them. I think that with suitable workmanship the device in the solution criticized can be made to work as specified in the description accompanying it.

is moved up and down the left path by cam groove *J* through bell crank *C*, connecting rod *E*, lever *D*, block *B* and slide *K*, back to starting point."

A study of the details will be necessary to gain a full comprehension of this solution. These show the construction of slides *K*, *H* and sliding block *A*.

PROBLEM II, SOLUTIONS NOS. 29 AND 30, FIGS. 2 AND 3. A. HANSON, NORWICH, NORFOLK, ENGLAND.

These appear to be simple solutions.

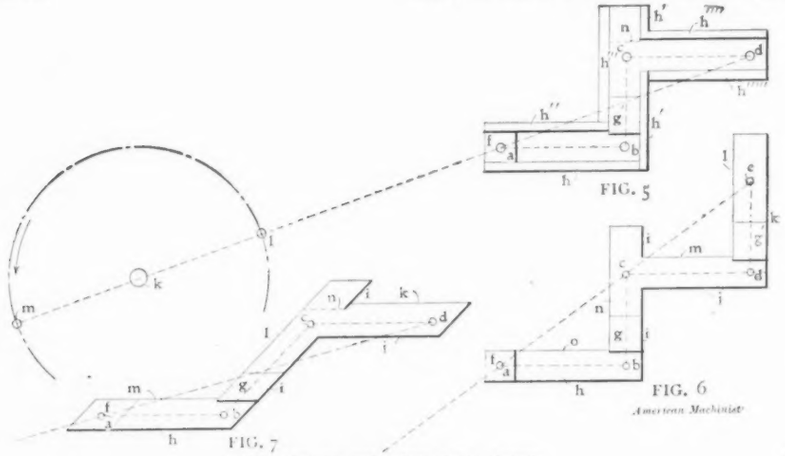
"*A*, Fig. 2, is a crank revolving continuously in one direction. *B* represents the connecting rod coupled to and actuating the links *C* and *D*, which actuate the slotted levers *C'* and *D'*. *E* is a center pin through the sliding blocks *F* and *F'*, and on which they are free to move. *G* represents stops which prevent levers *C'*

Referring to Fig. 3, "*E* is a horizontal cam wheel which may turn in either direction. Rollers *K* and *K'* run on pins projecting from slides *A* and *B*. These rollers are fitted into a cam groove *G* formed in *E*. The slides *A* and *B* have slotted arms *A'* and *B'* crossing each other at a 60-degree angle, as shown. The upward and downward movement of *B* moves *E* up and down in the slot of *A'*. The upward and downward movement of

A moves F upward and downward in the slot of B'. The cam groove is so laid out as to hold each of the slides A and B at rest while the other is moving."

PROBLEM II, SOLUTION NO. 31, FIG. 4. C. L. CARMAN, M. E., EASTON, PA.

To forestall the possibility of his having misunderstood any of the requirements of the enunciation of Problem II, Mr. Carman took the trouble to prepare three very finely executed drawings, one of which should surely meet all the conditions. The first of these shows how a point may be made to traverse the path stated in the problem. The second shows the concrete form or method of moving a *sliding block* according to the stipulated conditions, and the third was sent in case there should be some reservation of the space above the guides, corresponding to the limitation in Problem I. The principle of the movement is the same in each of the drawings, and I therefore avail myself of the second one, as in my judgment presenting the solution in the best form for clear elucidation.



THE USE OF THE SHUTTLE BLOCK.

In each of Mr. Carman's drawings the motion is derived from a continuously rotating crank wheel and communicated to the operating links by a pitman B. "The pitman attachment is made at the joint in the links which are suspended above and on the center line of the V-path, and swings the joint an equal and suitable distance each side of this center line. The lower link is extended to the point X below its pivot Z (the point that describes the V-shaped path) and carries at X a roller on its rear side, which engages with, and is guided by, a suitably formed groove, for the purpose of so directing the movement of that end of the lower link that, in conjunction with the movement of its upper end in an arc of a circle whose radius is the center length of the upper link, the point Z will travel the 60-degree, V-shaped path as required. As there is no possibility of the moving point Z departing from its predetermined path, depending upon the form of the groove and relation of the other parts, guides can perform no function other than that of maintaining the vertical position of the sliding block at all points in its travel." The device shown by Mr. Carman's drawing No. 3 has the actuating mechanism below the V-shaped path, and is provided with sliding block and V-guide.

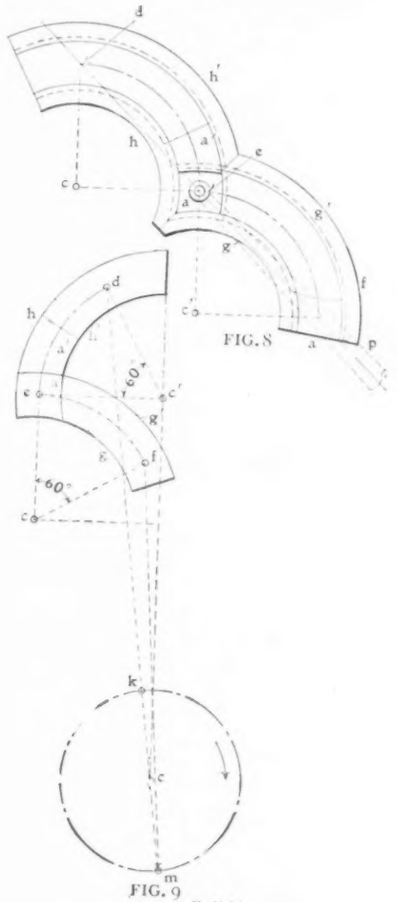
We now come to the consideration of the solutions offered for Problem III; but, before taking these up, I desire to say a few words on the scope of the auxiliary or shuttle slide, used by Carl J. Ulmann, of New York (Problem II, Solution No. 11, at page 727, and by myself in my solutions of Problems I and II).

The solutions referred to show that, by the aid of this mechanical device, it becomes easy to move a sliding block in a path of two branches, meeting and forming a right angle, or in a path whose branches form an acute angle. We shall see in the solutions of Problem III that by its aid a sliding block may be moved continuously over a quadrangular path. But in addition to the paths named it is possible, as well as mechanically practicable, to move a sliding block in paths probably not yet conceived of by most of those who have interested themselves in these problems, and undreamed of by the majority of those to whom slides are as familiar as household words.

Fig. 5 illustrates how a slide may be made to move over a path of three branches, $a\,b$, $b\,c$ and $c\,d$ ($b\,c$ forming right angles with $a\,b$ and $c\,d$) by the use of the single shuttle slide g. The inside margins of the ways are indicated at h, h', h'', h''', h'''' and h'''''. When the center of the sliding block f moves from a to b, it is in full engagement with g, as explained in my solution of Problem I. Then it moves over the branch $b\,c$, carrying the shuttle slide with it till the lower margin of the shuttle slide coincides with the dotted line n. Next it moves over the branch $c\,d$ to d. Returning it re-engages the shuttle slide at c, and moves from c to b. Here it disengages the shuttle slide g and lastly returns to a. The movement being effected by a pitman of the length $a\,m$ and a crank pin describing the circle $l\,m$, the entire path $a\,b\,c\,d$, will be traversed to and fro at each turn of the crank. The stops for the shuttle slide during its engagement with and disengagement from the shuttle slide g are not shown in the figure. They will be needed if the path to be described is not in a horizontal plane (compare with Fig. 5, page 583).

Fig. 6 shows how a similar slide may be made to traverse a path of four branches, the branches being in right-angular relation. Two shuttle slides, g and g', will be needed. The main slide is shown at a and the inner margins of the ways at h, i, j, k, l, m, n and o.

Fig. 7 illustrates the application of the shuttle slide in causing the slide to traverse an obtuse-angled path of three branches, a being the main slide and g the shuttle slide.



USE OF THE SHUTTLE BLOCK.

In Fig. 8 is shown a construction which will cause the center of the slide to traverse a path composed of two equal and similar curvilinear branches $d\,e$ and $e\,f$. Each of these branches includes 90 degrees of a circular arc, with radii $c\,e$ and $c'\,f$, respectively. The block is shown at a. Its sides are, respectively, of the same curvature as that of the inner margins of the ways which guide the block. The pitman P is shown in dotted outline. The center of block a describes the curved path $d\,e\,f$ back and forth at each revolu-

tion of the crank to which pitman *P* is connected. The shuttle slide is shown at *a'*.

Fig. 9 shows another curvilinear path *d e f*. The two branches *d e* and *e f* are each equal and similar, comprising 60 degrees of a circle, *e f* being described with *c f*, and *d c* with radius *c e*, *g*, *g'*, *h*

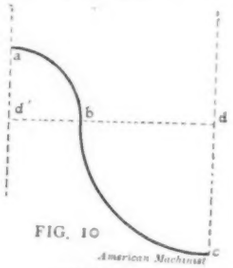


FIG. 10

PROBLEM IV.

and *h'* being the inner bearing surfaces of the guiding ways which control the movement of the sliding block *a*, while *a'* is the shuttle block. *C* is the crank center, *k m* the crank-pin circle, and *d k* length of pitman. The direction of movement of the crank pin is indicated by the arrow.

In all the angular paths the motion of the sliding block, when driven by a crank and pitman, will be much more rapid in traversing the intermediate branches, than in the extreme branches. As it is the sliding block proper that I have held in mind in presenting these problems, the restrictions imposed in their enunciation were for the purpose of directing thought to the control of its movement by guiding ways. In my own solutions of Problems I and II, I used the crank and pitman drive, not because this is always the best drive, but because it is the simplest. If regular rate of motion throughout the entire path in any of the possible paths be desired, this uniform rate can be secured by the use of cams, as has been amply demonstrated in quite a number of the solutions.

Now, the guiding of the axis of the cutter spindle in a sliding block in a curve of reversed flexure (*cyma recta* or *cyma reversa*) satisfactorily, has cost me so much thought that I think I could not

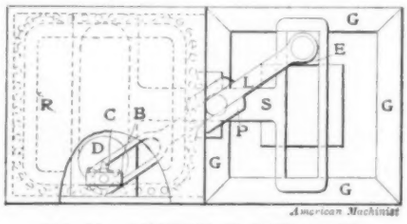


FIG. 11. SOLUTION OF PROBLEM III.

present a problem of greater educational value, and I will therefore include it in this series of problems. Fig. 10 shows the *cyma recta*, the upper branch *a b* being concave with respect to the line *a d'* while the lower branch *b c* is convex with respect to the same line. The *cyma reversa* has its upper branch convex, while its lower branch is concave to the line *d c*. If the figure be turned half around in the same plane as drawn, it presents the *cyma reversa*.

PROBLEM IV.

To make the axis of a cutter spindle in a sliding block describe a cyma recta, the direction of its motion being controlled by guide ways. It will be understood that the same movement of the block describes both the *cyma recta* and *cyma reversa*, the only difference in the meaning of the terms being that which defines the position of the curve in architecture with reference to a perpendicular line *a d'* or *c d* in Fig. 10. The path is to be described in a horizontal plane, this being the most natural position for ways guiding a block carrying a rotating wood cutter for cutting a wood molding or groove. The radius *b d*, of the lower branch *b c* of the curve, is to be half the radius *b d'* of the upper branch *a b*. I strongly recommend the study of this problem to those who are ambitious to excel as original designers of mechanism.

I will now turn to the solutions of Problem III, and present as many of them as my space limits will permit in this article.

PROBLEM III, SOLUTION NO. 1, FIG. 11. JOHN J. SINCLAIR, DETROIT, MICHIGAN.

Mr. Sinclair describes his solution as follows:

"The guides for block *E*, as called for in the problem, are shown at *G*. *E* is moved right and left by the slide *S*, and back and forth by the lever *L* which slides through piece *P* pivoted to *S*. As the pinion *c* rotates it moves block *B* along the guide *R*, carrying with it *C* and *D* which slide in the slots in *L* and *S*. *C*, *B* and *D* are rigidly connected so that *B* and *C* turn the corners on the center of *D* as a common center, *S* in the meantime being stationary, while *L* is moved back and forth."

Precisely so. As the pinion *c* rotates it moves *B*, *C* and *D*, but what rotates the pinion *c*? Readers of this solution will want to know this, and we shall feel obliged to Mr. Sinclair for further enlightenment.

J. A. Gerlock, of Philadelphia, Pa., sends a drawing and description which, as neither the one nor the other shows or implies any provision for holding the block square against its ways while its center describes the angles of the path, I cannot accept as a solution.

PROBLEM III, SOLUTION NO. 2, FIG. 12. P. S. BUSHNELL, LAKEWOOD, OHIO.

As the velocity of the sliding block is, in this problem, specified to be slow, I

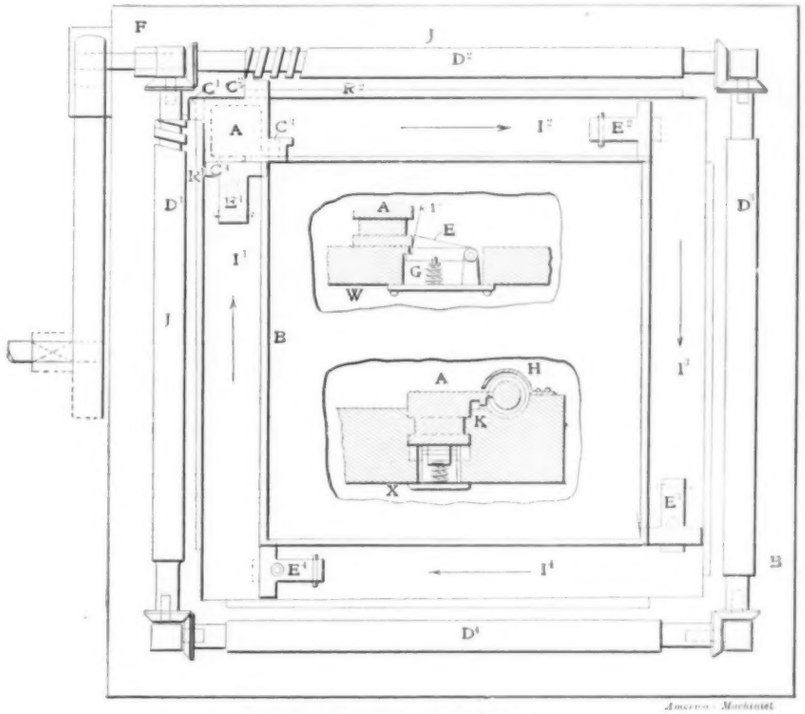


FIG. 12. SOLUTION OF PROBLEM III.

think a strong feed motion at a practically uniform velocity could be obtained in a carefully designed machine embodying his ideas, as expressed in the following description; but very nice and accurate workmanship would be needed to cause one screw to disengage at the instant its successor engages. I don't see how square-threaded screws could effect this, but I will present the solution.

"*A* is the slide designed to travel in the grooved ways I^1, I^2, I^3, I^4, in one direction about block *B*. D^1, D^2, D^3, D^4 are square-thread screws with their pitch of such a relation to the length of the travel of *A* that when the tracer on auxiliary slide C^3 traversing screw D^2 shall have reached the end of groove I^2, the tracer on C^3 shall engage the thread on D^3 at the instant C^3

is released. The relation between D^2 and D^4 at this instant is the same as is shown taking place between D^1 and D^2, which relation must also take place between D^3 and D^4, D^4 and D^1. Motion is transmitted to the screws by means of a driving pulley and belt, to pulley on shaft of D^2, thence by miter gears to the other screws. The auxiliary guides C^1, C^2, C^3, C^4, traversing parallel ways, as shown in section at K, Fig. 10, and dogs E^1, E^2, E^3, E^4, are for the purpose of preventing the tilting of slide A at the corners. Suppose A to be traversing I^1 in the direction of the arrow, and to have reached dog E^1, which it depresses as it passes over. Auxiliary guide C^1 holds it parallel until it has passed dog E^1. Guide C^1 then passes from its rail R^1, while C^1 is taking a position in front of rail R^2, and dog E^1 resumes its former position behind slide A, as shown at W, forming a guide coincident with the inner side of I^2. A then starts on its journey along I^2 by means of the tracer working in D^2."

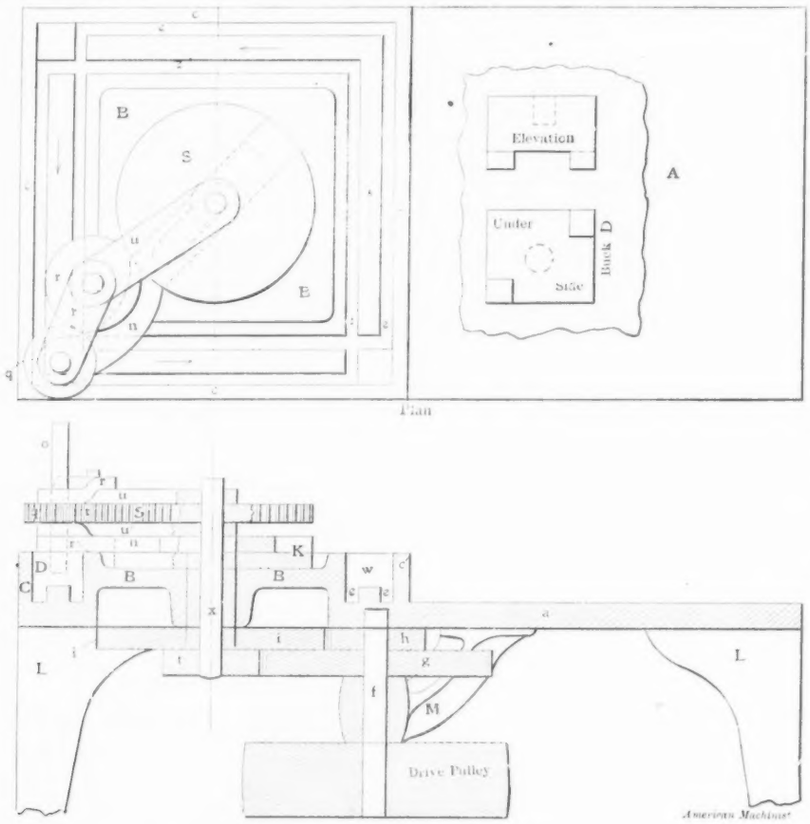


FIG. 13. SOLUTION OF PROBLEM III.

PROBLEM III, SOLUTION NO. 3, FIG. 13. E. PIERCE, ILION, N. Y.

As Mr. Pierce has included in his solution mechanism for driving the cutter spindle, his solution appears at first sight more complicated than it really is. The cutter-spindle drive is properly no part of the problem; it was mentioned in the statement of the problem merely to indicate a practical reason for moving a sliding block in a rectangular path, as I wish it understood that practical as well as theoretical considerations enter into the enunciation of all the problems which I present, notwithstanding that each problem is limited to the accomplishment of a specified movement. Problem III is explicitly stated in the last paragraph of No. VIII of this series, and though the object of the movement is previously stated, this object forms no part of the problem proper. If the cutter-drive mechanism be eliminated from Mr. Pierce's solution, it will be found extremely simple and susceptible of a strong, substantial design.

Referring to Fig. 13, "A is the table, B the square gray-iron piece located on the table as specified. The outside guides are shown at c. Grooves e are formed in the bottom of the channel w, as shown in the plan. The block D is provided with two square lugs on the under side. These lugs are integral with, and placed at diagonally opposite corners of, block D, and are fitted to run each in one of the grooves e, the latter being arranged in plan as shown. The legs of the table are shown at L, and M is a bracket supporting a bearing for mechanism below the table. P is a driving pulley keyed to shaft f, which actuates gears g and h, the latter meshing with i and revolving the hollow shaft j and slotted disk k. An arm n is free to slide in the slot in disk k, and is pivoted at its outer end to block D, which it moves with a slow, continuous motion in the direction indicated by arrows. The cutter spindle o is driven at high speed by a train of speed gears p, q, r, s, t, and carried by the jointed arms $u\,u'$, $v\,v'$, s and t being keyed to shaft x. Arm n is slotted and straddles shaft x".

PROBLEM III, SOLUTION NO. 4, FIG. 14. J. MELANCON, AMITE, LA.

As will be seen, Mr. Melancon's solution combines the screw drive of the sliding block employed by Mr. Bushnell, and the method of holding the block square employed by Mr. Pierce.

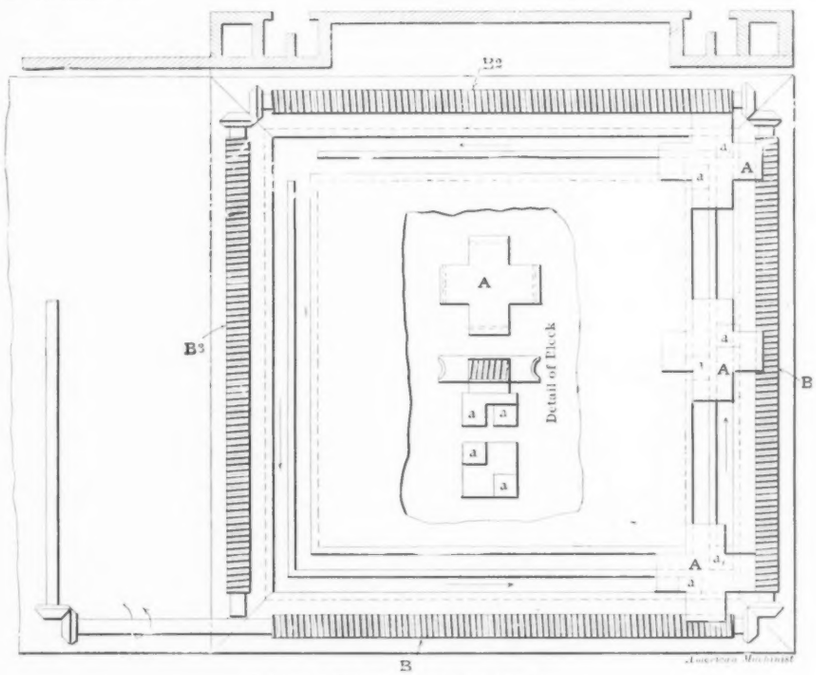


FIG. 14. SOLUTION OF PROBLEM III.

The main block A being shown in detail, both its screw-drive and the method of

guiding it are obvious. It will be seen that the lugs *a* and *a*, on the under side of block *A* are substantially the same, and operate substantially in the same manner as those shown by Mr. Pierce; while the screw-drive acts substantially like that of Mr. Bushnell. The sliding block *A* is shown in three different positions in the plan view of Mr. Melancon's sketch. The screws are shown respectively at *B*, B_1, B_2 and B_3.

A solution on very different lines has also been received from Mr. Melancon. It is reserved, with others, for the next article of this series.

As I do not expect to be snowed under with solutions of Problem IV, above enunciated, I will also state Problem V, scheduled in my program as the next to be presented. I will introduce this problem by a short story.

In the year 1884 I was requested to confer with a chemical manufacturing company with reference to a device for sifting a pulverized substance of very low specific gravity, which required to be passed through a sieve of extremely fine mesh. Trial had been made of various mechanical sifting devices, but nothing filled the requirements except sifting with hand sieves. The manufacture being in the nature of a secret process, I never learned what the material was. I was commissioned to invent and design a sifting machine that would, as nearly as possible, operate a sieve with the motion imparted to it by hand sifting. If the machine, when built, was sufficiently satisfactory, I was to receive a stipulated payment for it, waiving my right to apply for a patent therefor. If not accepted, I could do as I pleased with the invention. The company aiming to keep the process secret, did not wish to patent the machine if they accepted it, but pledged me to secrecy in our contract. They not only accepted the machine, but had a number built, in separate parts, at different machine shops, the castings being made at some foundry to me unknown, and the machines were assembled and set up at the factory of the company, one member of which was a trained machinist. As the machine was accepted and used by the concern, I assumed that, approximately at least, it met the requirements. The process was a commercial failure. The only surviving member of the company has given me permission to make this machine the basis of a problem in this series, but prohibits me from printing the name or location of the company, the general business of which has passed into other hands.

Problem V.

I shall not be able to properly state this problem (certain restrictions of space and position being imperative) without use of a drawing, Fig. 15, which includes a sectional elevation and plan of parts of the machine.

In the figure *A* is a cylindrical receptacle which received the pulverized material passed through the sieve. The sieve had a central sleeve which could be slipped over the part *T* of the spindle *S* till it rested on the shoulder *S'* of the spindle. This central sleeve was attached by light metal arms to the upper margin of the sheet-brass rim or hoop of the sieve, and the wire gauze was soldered both to the lower margin of the rim and to the lower part of the sleeve. From the bottom of the receptacle *A* arose a hollow column *C*, and the bottom was continuous with the hollow column and base *B* which rested on the floor. At the top of column *C* was bored out a bearing *S'* for spindle *S*. The lower end of the spindle was formed as shown at *E*. Assuming the inside diameter of *C* to be x'' (x inches) the height of the base *B*

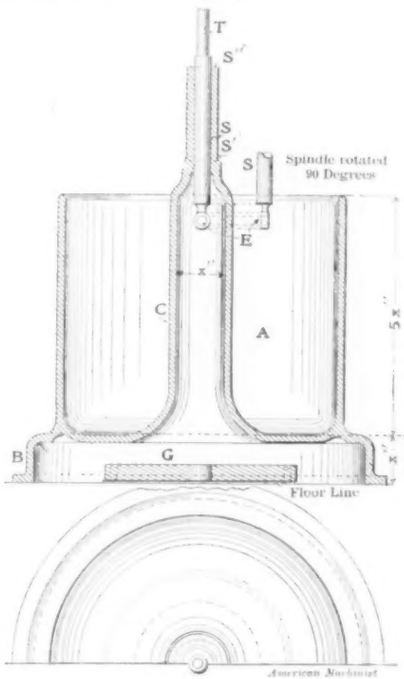


FIG. 15. PROBLEM V.

to be also x'' from the floor, the height of *A* to be $6x''$ from the floor line, and clear space below the floor to the ceiling to be $4\text{-}3x''$, by cutting out the floor on a circle having a diameter equal to the inside diameter of the base, *all the space available for operative mechanism was that contained within the hollow column C, the hollow base B and the space below the hollow base between the floor line and the ceiling.* The ceiling below the floor was not to be cut out except to provide a hole for extending a vertical shaft from a line shaft below the ceiling up into the space above specified as available, and to a horizontal spur gear *G* which was part of my design. Having thus stated the limits of space and dimensions, the problem to be solved is as follows:

The spindle *S* is to be made to turn on its vertical axis at the rate of not less than 60 turns per minute, in one direction only. The velocity of such rotation is to be accelerated to a maximum during the first half of each third of the rotation, and retarded to a minimum during the second half of each third of a rotation. During each third of the rotation on its vertical axis, the spindle is to be reciprocated up and down through a vertical distance of not less than one-third x''. The acceleration and retardation of the spindle in each third of its rotation on its vertical axis is to be uniform for each third. It is required to effect this by mechanism intermediate between a vertical shaft passing up through the ceiling into the interior space limits above specified, and the part *E* of the spindle *S*. No mechanism outside *A* can be allowed in the room where the machines are placed. The spur gear *G* used by me in the solution of this problem may be replaced by any mechanism that will effect the desired movement.

Solution for Putting in Iridescent Blue Colors.

Metal Industries states that a solution for putting in iridescent blue colors upon metallic articles can be made by dissolving 7 ounces of cream of tartar in 1 gallon of water, and 3½ ounces of tin salt in a quart of water. The two solutions are then mixed and boiled, and the precipitate produced in the operation allowed to settle. The clear solution is then poured off the precipitate and added with constant stirring to a solution of 6½ ounces of sodium hyposulphite in a quart of water. The combined solution is then heated to boiling, and the articles are immersed. They have to be taken out when the requisite shade is obtained. Another solution is obtained by dissolving freshly precipitated carbonate of copper in ammonia water. Copper-sulphate solution, of the strength of ¾ pound to the gallon, is precipitated by the gradual addition of a concentrated solution of sodium carbonate. The resulting copper carbonate is filtered off and well washed on the filter. It is then brought into another vessel and dissolved in ammonia water in such a manner that a small quantity of copper carbonate still remains undissolved, and the solution is therefore not too ammoniacal. Success with these solutions may not be obtained until after first trials, as the coloring of articles demands experience.

A very simple and very sensitive manometer, capable of indicating pressure differences of less than 1-16 millimeter of water, is described by M. H. Bellett. The device consists of an ordinary U-gage, which, however, contains no air in either branch, but is filled on the one side with a liquid miscible [mixable] with and slightly heavier than water, and on the other side with pure water.—*Mechanical World.*

Toolroom and Machine Shop Practice.

BY GEO. R. MARTIN.

All those who have had to do with gage making understand the necessity for taking precautions to avoid errors due to temperature; but in my opinion not sufficient note is taken of this source of error in the ordinary operations of the machine shop where considerable accuracy is required. For example, an ordinary slide-valve cylinder with valve chest cast on, in nine shops out of ten, will be bored out and finished at one setting. This procedure I have no quarrel with, so long as only one requires to be done; but for repetition work, and where accuracy is required, it has no excuse, as in the operation of boring, if anything like proper cuts are taken, considerable heat is generated and considerable distortion takes place from the unequal distribution of the metal; and although when finished and gaged immediately, it may be found parallel and circular, as soon as cold it will be found that it anything but fills this description. This is of course also the case where a plain shell casting is bored; but in this case, as a rule, the defect shows itself only as a taper bore. Therefore, when manufacturing in quantity, it pays and pays well to rough out only, leaving from .004 to .01 inch to take out in the finishing cut, and then put aside to cool before the finishing cut is taken; and no time scarcely need be lost if a register is made to fix on the lathe, in which the turned flange is dropped and bolted.

While on this subject, I will instance a common cause of spoilt work when boring in the lathe with a tool bar, especially where the casting to be bored is of any length. How many in such a case have put a roughing cut on, leaving perhaps 1-32 inch to be taken out afterward, and knowing also that the carriage travel was perfectly parallel with the headstock spindle, only to find, when the cut has reached the back end, that they have taken too much out and the work is scrapped. After this experience the majority are content to either take fiddling little cuts, and perhaps twice as many as necessary, or keep stopping the lathe and calipering carefully to see if the bore is not getting too large; then tapping the cross-slide handle, take off a little of the cut. Now, I hold that this is unnecessary. The pressure of the tool on the unsupported extremity of the cylinder simply causes it to give way and bend under it, as shown exaggerated in Fig. 1; consequently the bore being calipered and found to be under size, the cut is run forward until, as it gets nearer the rigidly held end, the turner suddenly discovers it is already bored too big or is just in time to bang the cross-slide handle with the nearest spanner to take the cut off a bit. If he will take the trouble to bore out the front of the cylinder dead to size, then bring the roughing tool up so that it just touches but does not take anything off, and then put the feed in, he can leave the cut alone, for it's going to be something less than gage size, whatever it is, and this repeated will just leave a skim for finish if the right-shaped tool is used.

KEYSEATING GAGES.

Some years since, when expressing the opinion that there was no reason why any part with proper care and attention should not be made interchangeable, I was met with the challenge that I could not make keys and keyways sufficiently near as not to require fitting, the conditions being that there should not be more than 3/8 inch difference in the distance the key should drive; this with a taper of 1/8 inch per foot, which meant that the accumulated error should not amount to .004 inch. This was in the days before the advent of the pillar keyseater and the wheels were

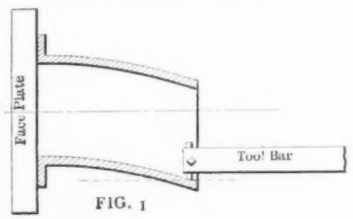


FIG. 1

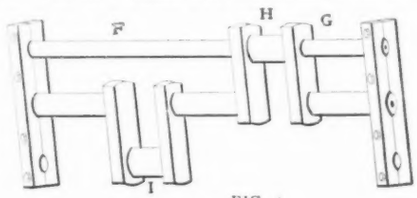


FIG. 4

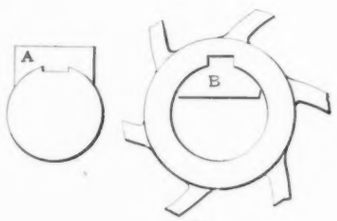


FIG. 2

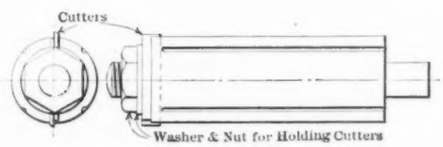


FIG. 5

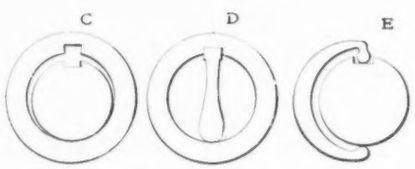


FIG. 3

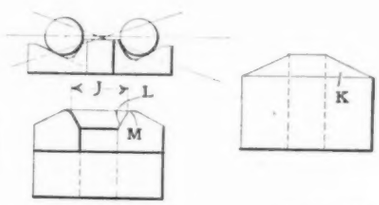


FIG. 6

American Machinist

TOOLROOM AND MACHINE SHOP PRACTICE.

keywayed on a slotter and I found the usual gage in use so common even at the present time; *A*, Fig. 2, showing the gage for the shaft, and *B* the one for the pulley. Now, just suppose that both the man who turned the shaft and the one who bored the hole ran things a bit fine and took a little too much off; suppose the shaft and bore to be nominally 5 inches, with a keyway 1/4 inch in the shaft and projecting 1/2 inch in the bore; and suppose the shaft to be .002 inch under size and the bore .002 inch over. Then with the gages as illustrated, if the keyway cutter makes the depth in each case absolutely correct, the distance as indicated at *C*, Fig. 3, is greater than it should be by exactly .004 inch, which is already your absolute limit, and naturally, with the usual cussedness of things in such circumstances as these, the keyways are sure to be cut deep, too; so that you have possible the error on shaft + error of bore + error of keyway in shaft + error of keyway in bore; where, with gages made as at *D* and *E*, it matters not how much the bore or shaft may be out, there is only the error of the keyway cutting which affects the ultimate result.

CRANKSHAFT FIXTURE.

Fig. 4 shows about the best fixture for turning a double crankshaft I have come across, although a somewhat expensive affair in first cost. The sketch pretty well explains itself; each dog is made up of two pieces of gray iron planed, bolted together, and bored with three holes, laid out to correspond to the throw of the crank, the center one being a tight fit on the crankshaft as roughed out, the other two just being a good fit for shafts *F* and *G*. These two shafts have hardened centers let into their ends. To set the dogs on the crank is a very short matter, as these are simply laid on a platen or the bed of the lathe. This at once brings all the centers parallel and the crank can then be set quickly with a surface gage for throws *H* and *I*, and the whole thing tightened up with the bolts before being placed in the centers. The bars *F* and *G* are made the correct length to butt up against the crank webs. Then, as all the thrust from the centers is transmitted direct to the pin being turned, there is little chance of any springing.

A BORING TOOL.

We had a job boring bearings of gray iron for agricultural work 2 1/2 inches bore by 15 inches long. These were being done in the lathe and the operation was taking altogether too much time, so I thought I

would try finishing them in one cut on a stiff vertical drilling and boring machine; so I had a bar made as shown in Fig. 5. The body part was made slightly smaller—I believe .002 inch less than the finishing bore—and it had four grooves cut in it for oiling. A large stud threaded with gas thread was inserted in the end, and this and the end of the bar were slotted to take the cutters. These were made of a piece of flat bar steel cut off and ground up, placed in position in the slot and held tight by the washer and nut. The tool was then ready for trial. Well, we had no trouble with the bar from the start, but the machine that had to do the driving protested and the thrust collars were ground out in short time; after this we had the spindle down and inserted alternate collars of phosphor bronze, and hard ened steel, but with no better result, so then we grooved the collars and drilled the spindle and fitted a drip lubricator, to keep it constantly supplied with oil; but the only result of the alteration was that the metal ground out and ran down the spindle mixed with the oil, as if it were being fed with emery. We eventually got over the trouble by placing one washer of vulcanized fiber to take the thrust, when all went well.

GAGE FOR BALL RACE.

One of the most difficult things I have struck so far has been to get the four-point ball-bearing races, Fig. 6, made properly. A friend made two attempts in his own shop to get this done, but the result was not good enough to pass. To make a thoroughly satisfactory job the angles of the ball races must be just right and also the diameter of the point of intersection of these two angles as shown. I succeeded in satisfying all the conditions of the job, but not myself with the method so I will state the way I went about it and will heartily welcome criticism. I did not trust laying it out on the drawing board for the angles, etc., but found all particulars by calculation, then chucked a piece of steel in the lathe, bored and turned it inside and outside to the correct diameter and setting the rest to the proper angle, turned the angle corresponding to the outside ball race as shown at *K*. Next, shifting the rest to the correct position for the other angle as at *L*, this was cut back until the sharp edge just measured the correct diameter as at *J*, which was then rounded off as shown at *M*, and then half was cut away as indicated, forming a gage for turning the ball-race to. The resulting race came out so exact that when a light coating of red lead and oil was given it and a ball placed in position and caused to roll round by tilting, it simply marked two rings upon the ball at the point of contact.

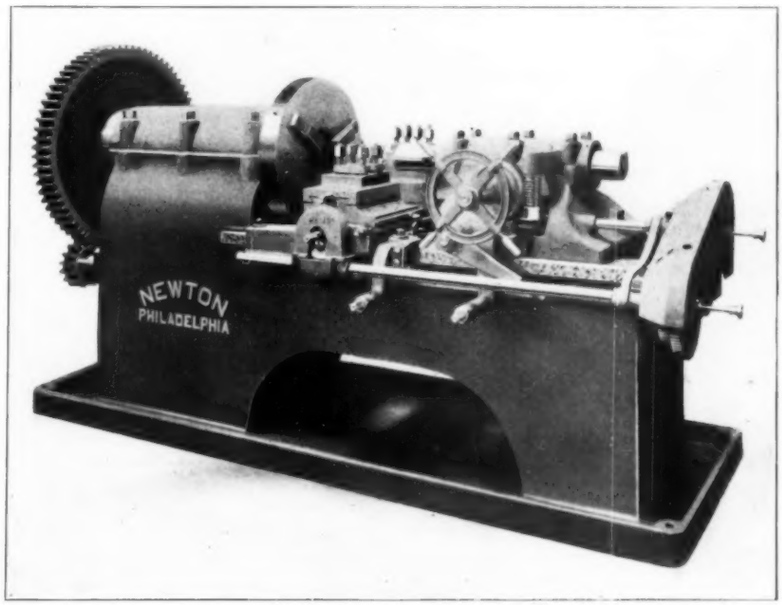
London, England.

Things are useless unless in the right place; a wishbone won't do for a backbone.

A Special Boring and Cutting-off Machine.

This machine is for drilling and cutting off armor nuts from the solid bar. It was recently built by the Newton Machine Tool Works, of Philadelphia, for the Bethlehem Steel Works.

The spindle of the machine—shown in the half-tone—is 11¼ inches in diameter, has a hole running through it and is fitted with a 24-inch Universal chuck at each end. It is driven by a 4-step cone—with 4-inch face—through spur gearing and back gears, and is arranged to take in a bar of 8-inch hexagon stock for armor nuts. The drilling spindle is 4 inches in diameter and has an automatic feed of 12 inches—through positive gearing—with three changes. In addition the tailstock can be adjusted on the bed. The cutting-off slides are fitted with front and rear rests so that two tools may be used in the cutting-off operation. These rests are operated simultaneously by a right- and left-hand screw, with three changes of positive feed, with automatic stop. The feeds for both the drilling and cutting-off heads are independent in rate and direction.



SPECIAL MACHINE FOR BORING AND CUTTING OFF ARMOR NUTS.

It is the intention on the larger sizes of nuts to drill a 2⅞-inch hole, and while drilling, the nut is being cut off, the automatic stop being so placed that the cutting operation will not be finished before the hole is drilled, the intention being to cut down to within a short distance of the diameter of the hole, and then cut all the way through after the hole is drilled.

Watches and History.

Watches were first made in 1500, therefore there can be no watch, no matter how crude, which is over 405 years of age. We therefore know that Henry VI of England could not have owned a watch, for he was born in 1421 and died in 1471, but Henry IV of France, or Henry of Navarre, might have possessed one, for he was born in 1553 and died in 1610. Brass plates for watches were not made until 1530 and watch glasses or crystals were not made until 1615. Enamel dials were introduced in 1635, the balance or hair-spring was invented in 1658, and the minute hand did not come into use until 1687. Watch jewels were first made in 1700 and the second hand was not used on watches until 1780. Now, if we are conversant with the approximate date of the various improvements made in watches we have data from which to figure age by what may be termed cancellation or rejection. Suppose we have a watch with a second hand and enamel dial and we are told it was made in 1600. We know this is not true, because the second hand was not introduced until 1780 and the enamel dial was not made prior to 1635. Therefore this watch in question cannot have been made prior to 1780.—*American Jeweler.*

Sir James Dewar, in recent lectures on "Flame" at the Royal Institution, gave the following figures showing the comparative efficiency—or, rather, inefficiency—of different lighting devices: Candle—Percentage of light, 2; non-luminous energy, 98. Oil—Percentage of light, 2; non-luminous energy, 98. Coal gas—Percentage of light, 2; non-luminous energy, 98. Incandescent lamp—Percentage of light, 3; non-luminous energy, 97. Arc lamp—Percentage of light, 10; non-luminous energy, 90. Magnesium lamp—Percentage of light, 15; non-luminous energy, 85. Cuban firefly—Percentage of light, 99; non-luminous energy, 1.

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Reciprocity.

Ever since most of us can remember we have been hearing a good deal about "taking the tariff out of politics" and of "putting the tariff questions in the hands of a board of experts." The tariff now seems likely to be taken out of politics to a greater or less extent, but the taking out is being done in a different way from that which has been contemplated and, we think, in a much better way.

We have before pointed out that, to put the tariff in the hands of a board of "experts," and especially of a board composed of experts holding their positions more or less permanently, is to abandon to that extent the basic principle upon which this government is founded and to adopt the idea upon which the Russian government is based. In Russia all questions of a political nature are supposed to be discussed and decided by experts. There is a council composed of members appointed by the Tzar, the members being chosen (theoretically) on account, solely, of their qualifications as experts and of their patriotic devotion to the interests of the people. In practice this works as badly as possible, and the reasons why such a plan of government can never possibly work otherwise than badly ought to be plain to everyone who knows anything whatever of history, or anything whatever of the basic principles upon which this and other free and representative governments are founded. It is simply impossible that the men composing such a body can represent the people of their country or be devoted to their interests unless they are chosen from among the people themselves and are made strictly accountable to the people who choose them.

And let no one deceive himself by supposing that the "more ignorant," the poor, or the despised classes, can be deprived of their rights without the process of deprivation being a continuous one, and going on till few, if any, have their rights. In Russia not only the poor and the uneducated have no rights, but manufacturers and the most intelligent and highly educated are deprived of them. However well educated and patriotic a man may be, there is always some other man who considers himself better educated and more patriotic and who will attempt to narrow political rights—confine them to members of his own class, or those whom he considers to be his equals. A tariff commission composed of experts would soon consider itself superior to manufacturers as well as to others, and we think the movement now taking place is much more wholesome and more likely to produce permanently good results. In New York the Merchants' Association has appointed a committee to consider the matter of reciprocity, and a reciprocity convention is to be held in Chicago, which it is expected will be attended and participated in by many manufacturers whose interests are directly touched by the tariff laws. Both these things are, so far as we can judge, entirely free of politics in the partisan sense and men belonging to all parties take part in them. If there is any virtue in the principle of representative government, as we must all believe there is, then there can scarcely be anything better for men to do than to meet and discuss such matters as are of common interest and to attempt to persuade other men to take the same view of public questions.

Incidentally, the circular letter issued by the Merchants' Association, of New York, includes several enlightening statements bearing on the question of reciprocity. After speaking of what European nations have done in the way of recent modifications of their tariffs, it says:

"The result of these new tariff systems adopted by the countries of Europe will be most disastrous upon the export trade of the United States. In addition to the high and prohibitive rates of duty imposed upon imports from the United States, our products will meet with the severe competition of other nations to whom the minimum tariff rates are conceded.

"The very serious situation that confronts the export trade of the United States to Europe will be realized when it is considered that our total exports to Europe during the fiscal year 1904 exceeded the sum of one billion fifty-seven million dollars, which was more than two-thirds of our total exports. . . .

"The new tariff system of the Empire of Germany, which goes into effect during the first half of the year 1906, not only doubles many of the rates of duty upon our chief articles of export, but also, by the reciprocal treaties entered into by Germany with a number of European nations, will place us at a still greater disadvantage. The same condition will shortly meet us in Austro-Hungary, where the proposed new tariff is expected shortly to be adopted. As an instance of the disastrous effect of these new high tariff rates of duty upon the exports from the United States, it is sufficient to mention the article of cotton-seed oil, the duty upon which will be quadrupled, which will destroy our cotton-seed oil export trade to that country.

"Russia raised her rates of duty on our exports by from 50 per cent. to 100 per cent. in 1901 in retaliation for the countervailing duty imposed by the United States on Russian sugar, and has now adopted a maximum tariff which increases these retaliatory rates of duty, and which will no doubt entirely check our export trade with that country. Our total exports to Russia in 1904 were $31,200,000, as against imports of $2,200,000.

"The Republic of France, after the passage of the McKinley act, adopted a high protective maximum tariff and a minimum tariff, with the result that during the last six years our exports to France have

shown no increase except in a few limited articles, on which France gave the United States reductions in duties in exchange for certain slight reductions granted by the United States under Section 3 of the Dingley act, and it is noteworthy that our exports to France covered by the reciprocal agreement have increased from 1893 to 1903 by 46 per cent.

"Italy granted us reductions under her minimum tariff on a limited number of exports, with the same result as in the case of France, namely, that our exports of the few articles on which Italy grants us her minimum rates have shown a very large increase, whereas our exports of such articles as are subject to the maximum rates have not increased materially.

"In Switzerland, which republic has always been a good customer of the United States, we shall be subjected to the maximum rates of duty under the new Swiss tariff shortly to be put in force."

After reciting these and other facts bearing upon the situation, the Association gives a copy of resolutions that have been adopted favoring the ratification of reciprocity treaties.

"Artificial" Ice.

The Technical World Magazine publishes an article entitled "How Artificial Ice is Made." The article goes on to describe how ice is *manufactured*. It is not, however, artificial ice, but is just ice. Whether it is made in a refrigerating plant or is formed outdoors, ice is ice, and if one wants to know how artificial ice is made, the place to learn is in a theatre, where they sometimes make artificial ice; that is, a thing which looks like ice, but is not really ice. Manufactured ice does not merely look like ice, but it is genuine ice, and is not artificial ice.

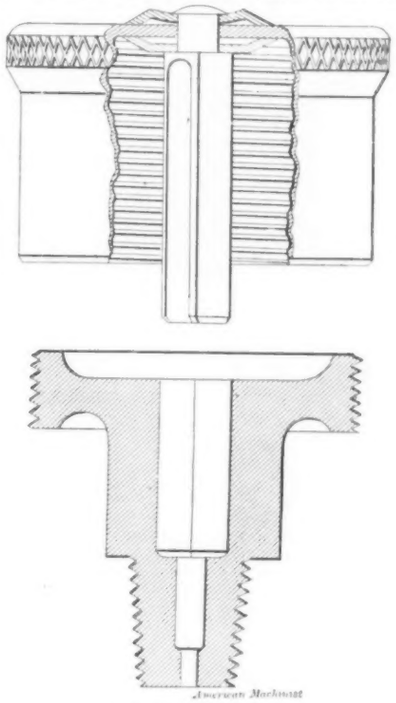
This is the way in which Prof. Langley tries to give us a little idea of the heat of the sun: "The heat of the sun is enormous beyond conception, for there is enough to warm two thousand million worlds like ours. Every minute there is enough of the sun's heat falling to the earth to raise to boiling thirty-seven thousand million tons of water. But the heat which thus falls on the earth is not a thousandth part of 1 per cent. of what the sun sends elsewhere, and all the coal beds of Pennsylvania, for instance, though they can supply the country for hundreds of years, would not keep up this heat during the one thousandth part of a second."

At Dayton, Ohio, a few days ago a man walked into a strawboard factory, picked up a brass roll 6 feet long and carried it off. His attorney pleaded that the boldness of the act entitled the prisoner to the consideration of the court, but he got sixty days and $200 fine. He should have been bold enough to have stolen the whole factory.

New Tools and Machine Shop Appliances.

A GREASE CUP.

The illustration shows a grease cup especially adapted for use in any place where there is excessive vibration as in

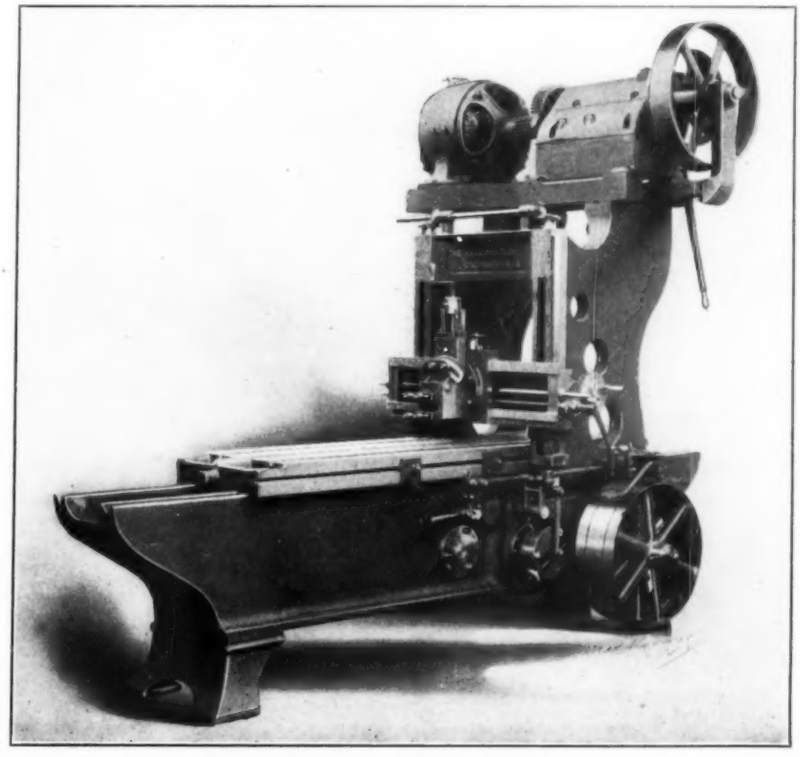


A GREASE CUP.

an automobile or engine connecting rod. In the center of the cap is a hole through which passes the round end of a square pin. The pin is riveted to two friction disks which bind the cap with a spring pressure and prevent it from turning when jarred. The sides of the pin are fluted to allow the passage of the grease to the bearing. The pin works in a square hole in the lower member of the cup which prevents it turning. This grease cup is made by the Erie Stamping & Manufacturing Company, Erie, Pa.

VARIABLE-SPEED MOTOR-DRIVEN PLANER.

At page 1354, Vol. 27, we illustrated a 48-inch planer, made by the Cincinnati Planer Company, arranged with six cutting speeds and one constant return. The half-tone herewith illustrates a 24-inch planer made by the same company, and similarly equipped, to give four cutting speeds and one constant return speed. The engraving shows very plainly how the power is transmitted from the motor to the constant-speed shaft by a pair of gears, one of which is fiber, to obviate any possible noise due to the high speed. The pulley for the return stroke is keyed tight to this constant-speed shaft and is made with a heavy flywheel rim to relieve the motor at the reverse; it is also supported on the outside by a separate bearing, which is made ring oiling. The pulley for the cutting stroke is mounted loosely on this same shaft, next to the return pulley. This loose pulley has a gear mounted on its hub, which extends to the box, and meshes with the gear on the lower shaft. As both of these pulleys



VARIABLE-SPEED MOTOR-DRIVEN PLANER.

rotate in the same direction the loose pulley only rotates on the shaft to the extent of the difference in the two speeds. All the gears and driving hubs are made of steel, and are completely encased in a gray-iron box holding several gallons of oil, thus keeping a constant flow of oil on all the running parts. The gear box is equipped with two shafts, each carrying one set of gears, the power being transmitted from the top shaft to the lower one, and from there to the gear on the pulley hub. All of these changes are made by simply moving the one lever shown, which controls all four cutting speeds. This lever also carries an index plate so that the foreman or operator can see at a glance what speed is being used. The change from one cutting speed to another can be made at any time whether the machine is in operation or standing idle, with the only exception that it is not advisable to make these changes while the tool is taking a heavy cut. This same variable-speed box can be used on a planer without a motor, by leaving off the gear on the top shaft and putting on tight and loose pulleys instead.

CYLINDER GRINDER.

This is a machine which has been developed for the accurate finishing of gas- and gasolene-engine cylinders and internal grinding of parts which are of such shape that it is impractical to rotate them. The advantages of grinding over smooth boring or reaming to obtain a suitable finish are well understood by the "up-to-date" mechanic. In the construction of automobile engines, especially, the walls are necessarily thin, and when the surface is finished by boring or reaming there is a continual tendency for the iron to spring away from the cutting tool, and if there are hard and soft spots in the casting, it is almost impossible to have the boring tools cut a perfectly round hole. With grinding, however, this is not the case, and it is believed that grinding operations in engine cylinders mean better workmanship and finish, less leakage past the rings, less expense in lapping out and running in and less time to get the cylinder in perfect working condition.

The machine as a whole is shown in Figs. 1 and 2, and consists of a column carrying at the top a grinding spindle which revolves about a horizontal axis. This grinding spindle is mounted in double eccentrics giving a sort of a planetary motion to the spindle and grinding wheel, which makes a peculiarly effective device for getting the correct diameter of the holes and insures their being round and of uniform diameter. This construction will be understood from Fig. 3, where *A* is a large eccentric sleeve and *B* an inner eccentric. Between these, bronze bushings *C* are fitted, which are made tap-

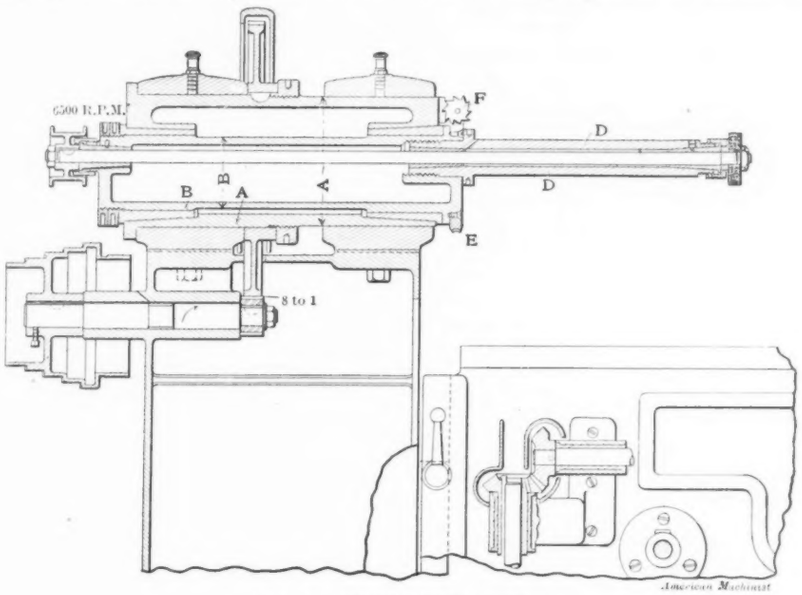


FIG. 3. SPINDLE MECHANISM.

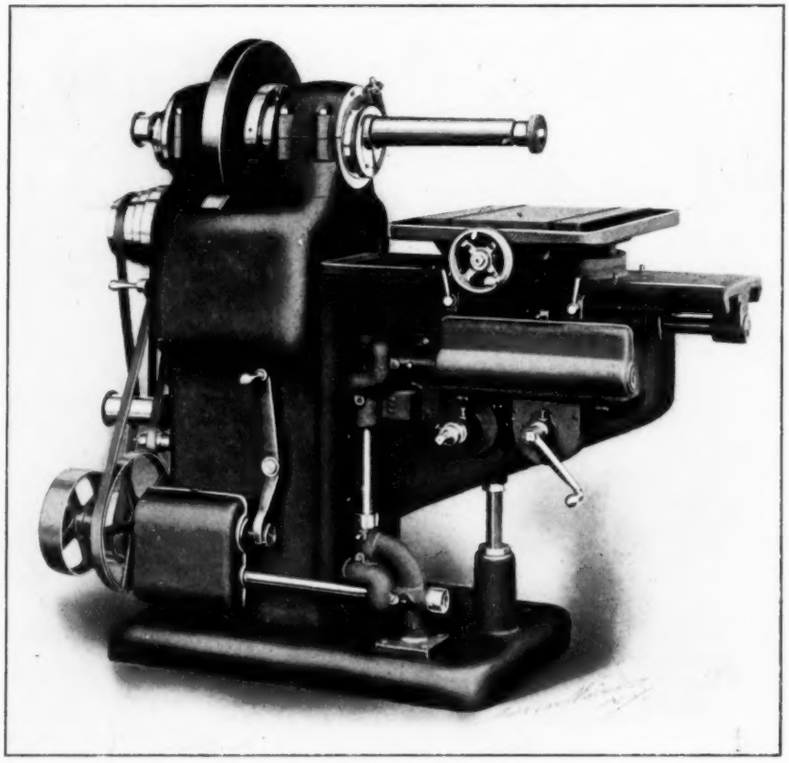


FIG. 1. CYLINDER GRINDER.

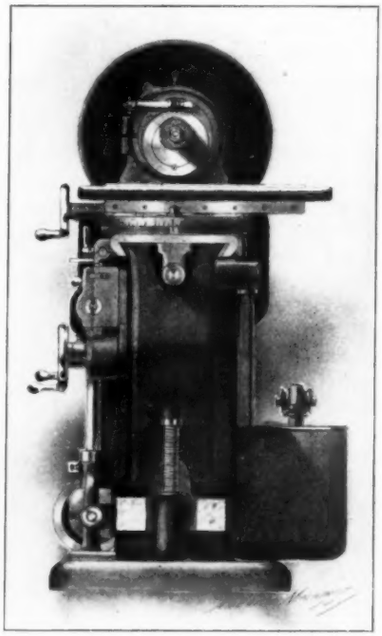


FIG. 2. CYLINDER GRINDER.

ering on the outside to give take-up for wear. *D* is the extension spindle.

The inner eccentric *C* and extension spindle *D* are rotated in the large eccentric by means of a worm and worm gear *E*, the worm being mounted on the same shaft with a star wheel *F*, which co-acts with a stop on the head so that one tooth will feed out the wheel 1-1000 inch. The half-tones show this feed gear clearly. This construction enables the wheel to be fed out to regulate the depth of the cut when the machine is in motion. A peculiar feature in connection with this is that the radius increases quite uniformly for a given distance that the worm wheel is turned. That is, if the worm is turned one revolution, the amount that the radius is increased is very near uniform at any position up to nearly the extreme travel.

Eight different speeds of rotation are given to the eccentrics to handle the work of different diameters and conditions. At the rear of the machine, about on a level with the small pulley driving the grinding spindle, is mounted an arm carrying two idler pulleys around which the belt runs, and this provides "give and take" to allow the belt to follow this pulley through its circular path whether the throw be large or small. The wheel spindle is hardened and ground and runs in bronze boxes provided with adjustment for wear. The end

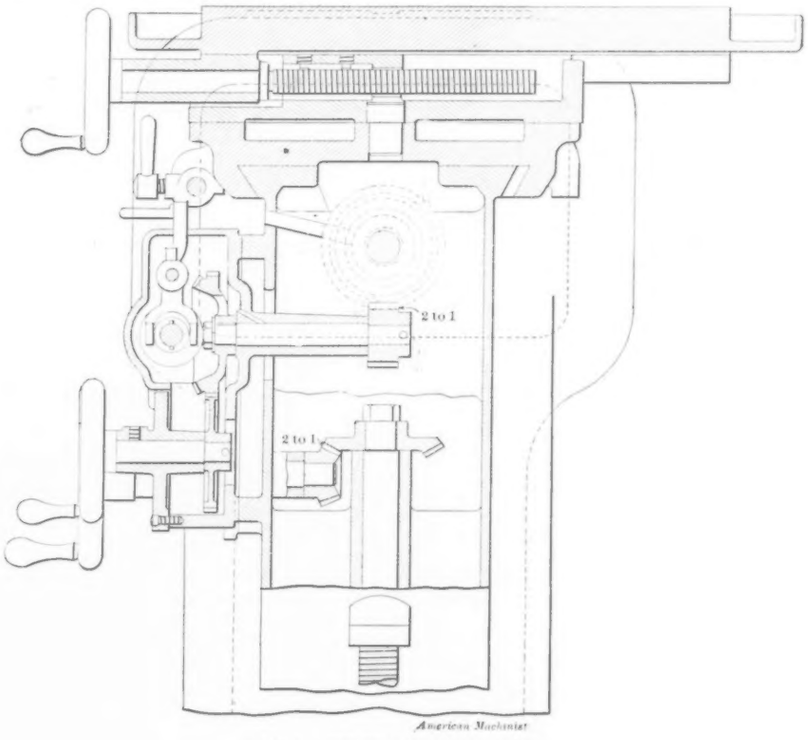


FIG. 4. SECTION THROUGH KNEE.

of the spindle is made tapering to receive wheels mounted on collets, thus allowing wheels to be changed without delay in truing up.

The knee on the front of the column carries the main table, which travels back and forth in a line parallel to the grinding spindle. On the top of this table is a second adjustable table for giving cross-wise adjustment, and both elevating and cross-slide screws have micrometer dials. The method of mounting the tables is shown in Fig. 4. The work is held in position by means of fixtures on the table —an easy method of handling it when large or out of balance, so that it is impractical to rotate it. This method of handling the work also makes it possible to grind duplex as readily as single cylinders. By means of the vertical adjustment of the knee and the cross movement of the upper table any adjustment of the work can be obtained, either to bring a single hole in line with the grinding spindle or to transfer the work from one hole to another, which is of course necessary when duplex cylinders are to be ground. The travel of the table is auto-

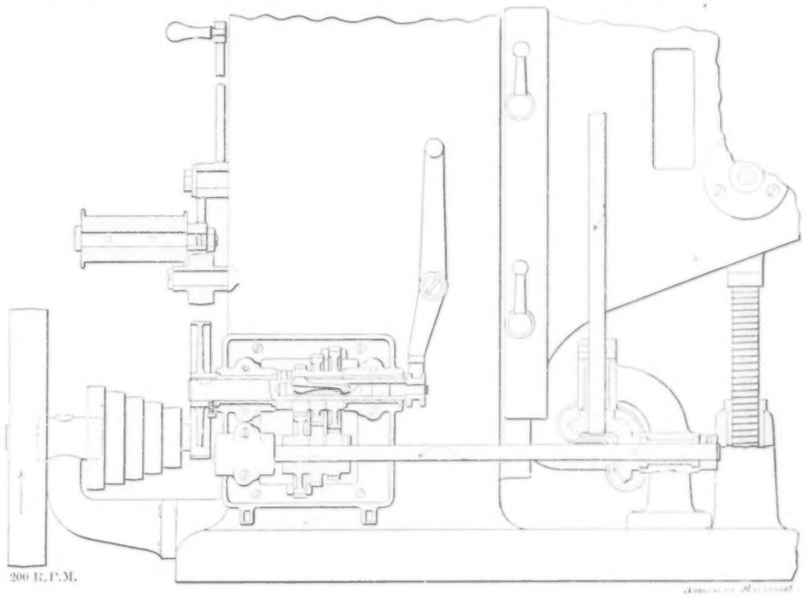


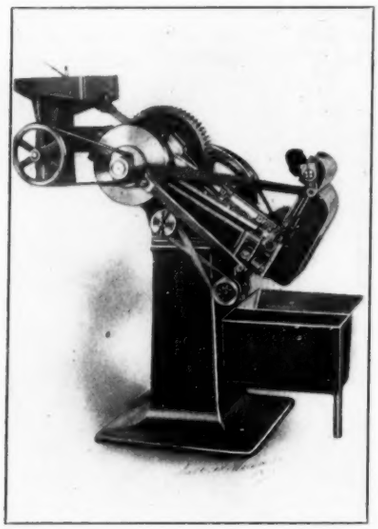
FIG. 5. FEED DRIVE.

matic, reversing accurately at any point desired. The rate of traverse is controlled by a gear box on the column of the machine giving three different rates of feed to the table. The interior of this box will be seen in Fig. 5. The machine shown will grind holes up to 7 or 8 inches in diameter by 15 inches in length, as well as though the parts were in shape to be rotated in the usual way. The vertical adjustment of the knee of the machine is 4½ inches, and the cross adjustment of the table, 9 inches. The main table is 45 inches long by 13 inches wide, with a finished top 23 inches long by 11 inches wide. The cross-slide table has a working surface 20x14 inches. The greatest distance of the main table below the center of the grinding circle is 12 inches. The grinding wheels are 3½ inches diameter by ¾ inch thick. The Heald Machine Company, Worcester, Mass., is the builder.

RIVET-BIFURCATING MACHINE.

The accompanying half-tone shows a new broaching machine for bifurcating rivets automatically. The rivets are placed in the hopper, from which they are fed through the conductor to the feed slide; this feed slide pushes the bottom rivet over to the holding dies, where it is held rigidly while the broach is pushed through the rivet, finishing the cutting at one stroke. The broach has a cutting stroke of 8 inches, and operates under a flood of oil, as the machine is fitted with oil tank and pump to lubricate and keep the tool washed clean of chips. The machine is

geared 4 to 1, has a balance wheel 20 inches diameter by 3 inches face, and will bifurcate rivets ¼ inch diameter, 7-16 inch deep, at the rate of thirty per minute; it can be fitted to work rivets of various diameters below ¼ inch, with varying depths of bifurcation. The Rowbottom Machine Company, Inc., of Waterville, Conn., are the builders.



MACHINE FOR BIFURCATING RIVETS.

Personal.

Edgar G. Seaman has assumed charge of the New York office, 120 Liberty street, of the S. Obermayer Company, manufacturer of foundry forgings and supplies.

Scott H. Simon, formerly of Youngstown, Ohio, has been elected treasurer and general manager of the Carlyle Johnson Machine Company, Hartford, Conn., in place of Jas. F. Barr, resigned.

Fred Johnson, for the past ten years foreman of repairs at the Morse Twist Drill & Machine Company, has resigned his position to accept a similar one with the Union Twist Drill Company, of Athol, Mass.

At the annual meeting of the Woodward & Powell Planer Company, Worcester, Mass., E. M. Woodward was elected president and treasurer; A. M. Powell, vice-president and superintendent; and J. W. Robinson, secretary.

Obituary.

Thomas Jackson Shaw died at his summer home, Holly Oak, Del., July 20, fifty-three years old. Mr. Shaw was born in Delaware and learned pattern making and then became a draftsman in the Dialogue shipyard at Camden, N. J. In 1876 he became chief draftsman for the Harlan & Hollingsworth Company, Wilmington, Del. He later became chief engineer of the plant and vice-president of the company. Physical disability compelled his retirement several months ago.

Business Item.

The Dayton Hydraulic Machinery Company has opened a New York branch office at 133 Liberty street. It will carry a line of Brooks centrifugal pumps. R. E. Spencer Geare, M. E., is sales manager.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed; working drawings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Wanted—Air compressor with 8 or 10 in. duplex steam and compound air cylinders. Box 372, AMERICAN MACHINIST.

Cam layouts made for B. & S. auto. screw machines, giving greatly increased production; send sketch for estimate. Box 422, AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

We want machine shop work, also nickel and oxidized bronze plating. Have big shop and best facilities for pattern work, diemaking and all kinds machine work. Large contracts wanted. Michigan Automobile Co., Ltd., Kalamazoo, Mich.

Engineer's License.—Engineers, electricians, firemen and machinists, send for 52-page pamphlet describing "Spangenberg's Steam and Electrical Engineering," just out; best book ever published; sent free. Geo. A. Zeller Book Co., 20 S. 4th st., St. Louis, Mo.

For Sale.

For Sale—A machine shop in southern Michigan, doing good business; price reasonable. Address Box 293, AMER. MACHINIST.

For Sale—Weekly copies, 1899-1900; monthly copies, 1901, 1902, 1903, 1904, 1905, AMERICAN MACHINIST. R. A. L., care AM. M.

One 125-lb. belt-driven Lingle power hammer; hammer in perfect condition; absolutely good as new machine; St. Louis delivery, 30 days. Box 397, AMERICAN MACHINIST.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

Business Opportunities.

Wanted—Correspondence with parties who can take on a going gasoline motor business; a good, sure market at good prices already established. Address "Motor," care AM. M.

An old-established hardware manufacturing concern, manufacturing articles made from cast iron, cast brass and small stamped goods, located in New York city and doing a business of $50,000 per annum, which could be easily increased to $75,000, desires to turn over the entire manufacture of these articles to a concern in a similar line and who are situated within 100 miles of New York, with good shipping facilities, and must have an iron foundry; they to take over all machinery, tools and patterns, and we to dispose of the entire output. The concern is now running in full force and intends to do so for some time to come. Box 414, AMER. MACH.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

General manager, with large experience in organizing new and old manufacturing plants in United States and Canada, is open for engagement; technical graduate; age 35. Box 348, AMERICAN MACHINIST.

CONNECTICUT.

Designer; 15 years' experience tools for interchangeable manufacture, press feeds, ammunition, rivet and special machinery. Box 391, AMERICAN MACHINIST.

ILLINOIS.

Machinery salesman, with practical knowledge and experience in manufacturing and selling, now Western sales manager for prominent Eastern company, desires change; correspondence, with particulars, invited. Box 342, AMERICAN MACHINIST.

INDIANA.

An experienced mechanical draftsman, technical graduate, wants a position. Box 409, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Position as factory manager, manufacturing metal goods, preferably automobiles; have had excellent experience; well up in all modern systems. Box 404, AM. M.

NEW JERSEY.

Expert toolmaker wants position as foreman on small interchangeable work. Box 399, AMERICAN MACHINIST.

Expert Jones & Lamson flat turret operator desires change; take charge or operate. Box 423, AMERICAN MACHINIST.

First-class patternmaker and draftsman wants to change for wife's health. Address C. L. J., care AMERICAN MACHINIST.

Foreman blacksmith, thoroughly up to date, who can handle drop, trip and steam hammer work, executive ability and systematic, desires change. Box 410, AMER. MACHINIST.

NEW YORK.

Draftsman, quick detailer, neat tracer, wants position. Box 403, AMERICAN MACHINIST.

First-class mechanical draftsman wants to change; New York or Brooklyn. Box 417, AMERICAN MACHINIST.

Die and tool maker wishes steady position; man of 26; sober and industrious habits. Box 416, AMERICAN MACHINIST.

Automobile engineer, extensive experience designing commercial vehicles; open for engagement. "Electro," care AMER. MACH.

As a draftsman or assistant in engineer's office; graduate in steam and machine design, Pratt Institute; short experience. Box 401, AMERICAN MACHINIST.

Superintendent, good executive and manager, will consider proposition of $4,000 a year or better; can make your plant pay. Box 412, AMERICAN MACHINIST.

Mechanical draftsman, technical education, extensive experience in drafting room and shop, good references, 28 years old, desires position. "H. S.," care AMER. MACHINIST.

Mechanical engineer (34), practical toolmaker, expert designer of automatic machinery and experienced in organizing for production on modern lines, desires change. Box 411, AMERICAN MACHINIST.

Position as mechanical superintendent or general foreman; 36 years old, progressive and energetic; special experience in electric elevator manufacturing and well acquainted with their latest types. Box 418, AM. M.

Foreman machinist, 7 years foreman, progressive, cost-reducer, experienced on engine, gasoline motor, experimental and tool work, desires position as foreman or assistant superintendent. Box 415, AMERICAN MACHINIST.

Draftsman and designer of jigs, fixtures, tools for interchangeable manufacture; inventive ability, technical and practical man, at present employed with large manufacturing concern as foreman of tool-making department, desires change; references. Address Box 400, AMERICAN MACHINIST.

OHIO.

Mechanical engineer and expert designer, with long and varied experience, Corliss engines, power transmission, gas engines, is open for engagement; competent to take charge, and accustomed to the control of men. Box 385, AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman, German, of 26, 8 years' practical experience on steam engine and general machinery, 2 years' technical education, wishes position. Box 421, AMER. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Three first-class toolmakers, capable of doing small, accurate work; men experienced on a fine class of watch factory die work preferred. Apply Veeder Mfg. Co., Hartford, Conn.

GEORGIA.

Wanted—An up-to-date machine shop foreman, to work about 100 men; we want a man who has a good job and looking for a better one, and those without a job need not apply. De Loach Mill Mfg. Co., Atlanta, Ga.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

Experienced office men, draftsmen, foundry chemist, foremen, stock, departmental and cost clerks, and mechanics for large concern with rapidly growing business, including foundry, machine shops and sheet metal and wood-working departments; high-grade work, including automobiles. Box 413, AM. MACH.

LOUISIANA.

Wanted for the South—One first-class machine tool salesman; also one well-posted machine tool office man; must be young and vigorous. Box 376, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—First-class draftsman with experience on printing presses. Campbell P. P. & Mfg. Co., Taunton, Mass.

Wanted—Experienced milling machine operator, competent to take charge of several machines on printing-press work. Campbell P. P. & Mfg. Co., Taunton, Mass.

To meet our constantly increasing requirements for first-class draftsmen, machinists and molders, we solicit applications in writing, with references. These will be carefully investigated and our selections made from the list of suitable applicants thus maintained. Our plant is entirely new, thoroughly equipped and well located 10 miles from Boston. Refer to this ad., and address Labor Bureau, B. F. Sturtevant Co., Hyde Park, Mass.

MICHIGAN.

Wanted—Experienced man to superintend sheet metal department in a large automobile factory; one who is accustomed to the latest and most modern machinery and methods; one who is familiar with automobile work preferred, such as coolers, hoods, fenders, water jackets, etc.; to the right man, attractive, permanent position; state age, salary, experience, references. Address Box 424, AMERICAN MACHINIST.

Wanted—Experienced machinists and toolmakers; men who have been accustomed to accurate work by modern methods can secure steady employment and good wages. Detroit is growing rapidly; is already one of the great industrial centers; there are new factories being built, and others enlarged, and there is a great demand for competent and high-grade mechanics. State age, wages, experience, references. Leland & Faulconer Mfg. Co., Detroit, Mich.

NEW JERSEY.

Wanted—Salesman or manufacturer's agent; must be thoroughly familiar with engine packings and mill supplies; state experience, reference and salary expected. Box 402, AM. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class draftsman, erectors, boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Several draftsmen wanted by large concern in New York city; steady employment to suitable men; state age, experience, salary and two business references. Box 419, AM. MACH.

Draftsmen.—Wanted—Two or three good electrical mechanical draftsmen; state experience, reference, age and salary expected; permanent position to right men; 30 minutes from New York city. Box 420, AM. MACH.

Wanted—Expert semi-automatic turret lathe operator; one who can operate and demonstrate to customers on the road the efficiency of same; capable of devising tool equipment for the greatest production; must be up to date and a hustler; give references as to experience, ability, character and salary expected. Address "B.," care AMER. MACH.

Young man for editorial work on a machinery journal, which is devoted to machine tools and machine shops; work will include writing descriptions of machines and shops, preparing manuscript sent in by contributors, and some traveling on trips of observation; applicant must have had shop experience, be interested in shops and able to write straight English. Address Box 384, AMERICAN MACHINIST.

OHIO.

Wanted—Vise and planer hands. The Niles Tool Works Co., Hamilton, Ohio.

Wanted—Six first-class erecting machinists, used to heavy work; good pay to the right parties and steady employment; reply at once, stating age and experience. Address Box 408, AMERICAN MACHINIST.

PENNSYLVANIA.

Wanted—A1 diemaker for sheet metal work. Box 398, AMERICAN MACHINIST.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

A first-class toolmaker, accustomed to designing jigs; give experience and wages expected. Box 407, AMERICAN MACHINIST.

Wanted—One or two good Corliss engine erectors and floor hands; also one or two sheet iron workers. Scottdale Foundry & Machine Co., Scottdale, Pa.

A working foreman for machine shop; also one for erecting floor; must be familiar with gas-engine work; state experience and salary. Box 406, AMERICAN MACHINIST.

Wanted—Experienced draftsman in electrical apparatus, etc.; only first-class men need apply; state experience and salary expected. Address Box 382, AMERICAN MACHINIST.

Wanted—At once, a number of first-class machinists, experienced in machine and floor work on engines; good wages and steady employment to first-class men. Jacobson Machine Mfg. Co., Warren, Pa.

Lathe department foreman wanted for modern plant in Pittsburg district, building rolling mill and special machinery; good position for hustler able to get out duplicate work; state experience, age and give references. Box 405, AMERICAN MACHINIST.

RHODE ISLAND.

Wanted—Toolmakers who have had considerable experience on jig and fixture work; only first-class men need apply. Mechanical Accountant Co., Providence, R. I.

Toolmakers wanted; first-class workmen, experienced on jig and fixture work, for light high-grade machinery. Call or address, The Taft-Peirce Mfg. Co., Woonsocket, R. I.

WEST OF MISSISSIPPI.

Wanted—Foreman for machine shop located in Western town; class of work, hoisting engines. Address, with reference, "O.," care AMERICAN MACHINIST.

WISCONSIN.

Wanted—Mechanics to design and construct parts for automobiles; competent men can have steady positions, with prospects for advancement. Address Thomas B. Jeffery & Co., Kenosha, Wis.

Wanted—Draftsman for designing, with little instruction, parts of automobiles; good wages to the right man. Address Thomas B. Jeffrey & Co., Kenosha, Wis. (manufacturers of automobiles).

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See Roller Bearings.

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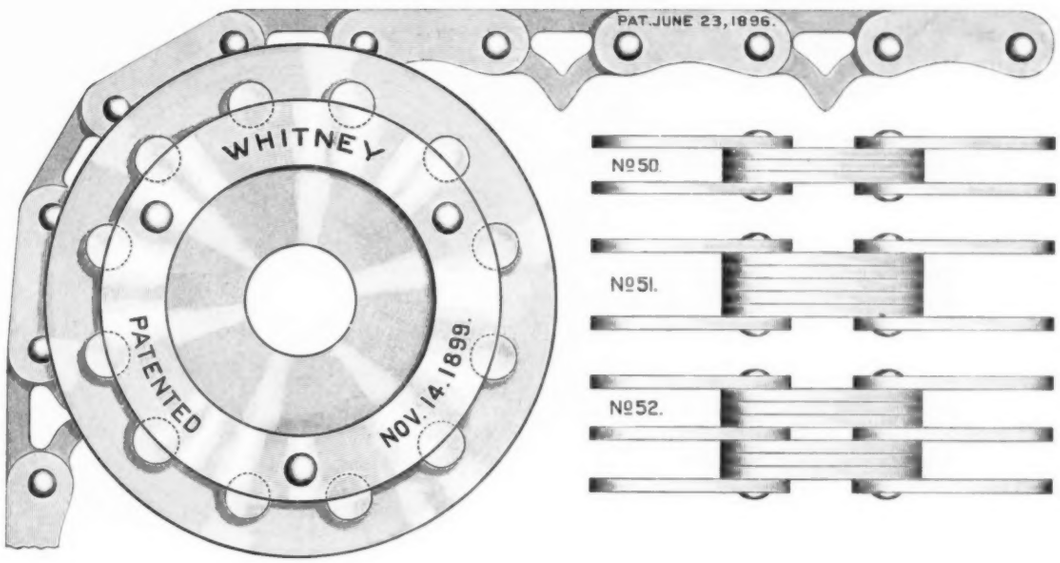

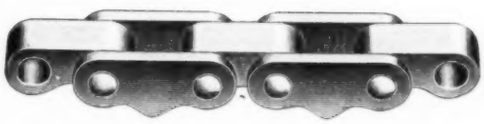

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Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

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Hill Pub. Co., New York.
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Barnes Co., W. F. & John, Rockford, Ill.
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Betts Mach. Co., Wilmington, Del.
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National Machinery Co., Tiffin, O.

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Armstrong Bros. Tool Co., Chicago, Ill.
Walker & Co., O. S., Worcester, Mass.

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Athol Machine Co., Athol, Mass.
Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
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Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
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Case-Hardening
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Franklin Mfg. Co., Syracuse, N. Y.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

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Binner-Wells Co., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

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Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.,
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
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Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
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Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
Walker & Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Circuit Breakers
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Smith Co., Chas. G., Pittsburg, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

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Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

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Evans Friction Cone Co., Boston, Mass.

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Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
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Almond Mfg. Co., T. R., Brooklyn, N. Y.
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Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
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Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
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Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
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Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

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Underwood & Co., H. B., Philadelphia, Pa.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Cupolas, and Ladles, Foundry
Byram & Co., Inc., Detroit, Mich.
Northern Engineering Works, Detroit, Mich.
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Paxson Co., J. W., Phila., Pa.
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Warner Instrument Co., Beloit, Wis.

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Brown Co., H. B., Easthampton, Conn.

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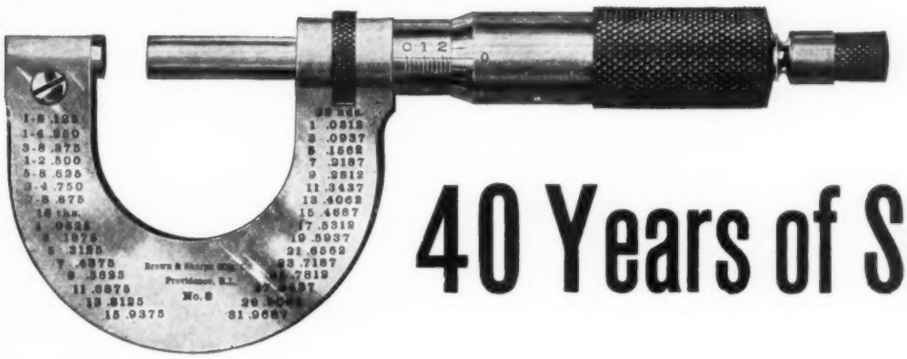
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.



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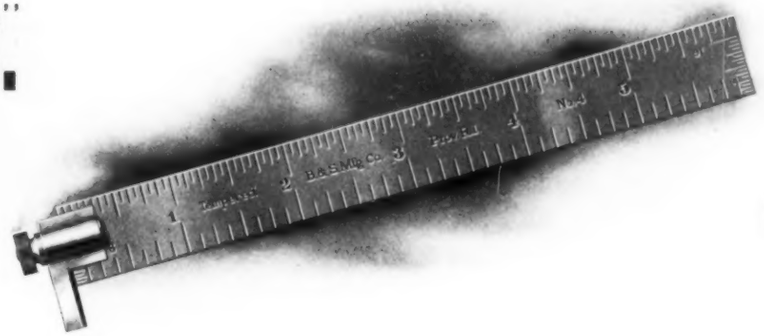

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Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
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Barnes Co., W. F. & John, Rockford, Ill.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Niles-Bement-Pond Co., New York.
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Ridgway Mach. Tool Co., Ridgway, Pa.
Smith Co., Chas. G., Pittsburg, Pa.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.

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Emery Wheel Dressers
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Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

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Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Abenaque Mach. Wks., Westminster Station, Vt.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

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Binner-Wells Co., Chicago, Ill.

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Gorton Mach. Co., Geo., Racine, Wis.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Philadelphia Bourse, Phila., Pa.

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Badger & Sons Co., E. B., Boston, Mass.

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General Electric Co., New York.
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Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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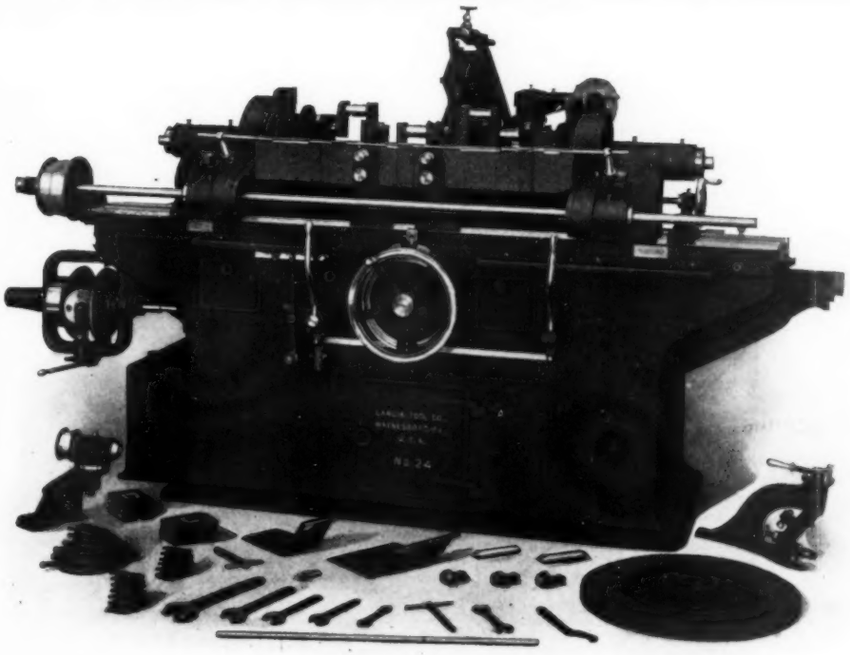
Bradley & Son, C., C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.



No. 24 Crank Grinding Machine

Especially Suited for Automobile and Gas Engine Manufacturers

This new design Landis Grinder is the result of our strenuous efforts to produce an ideal machine for grinding single and multiple crank shafts for gas, petrol and small steam engines, such as are used in the manufacture of automobiles, launches, etc. It will handle multiple cranks with throws up to 6 inches, and single ones with throws up to 12 inches.

It will produce a degree of accuracy on this kind of work impossible to secure by any other method. All the well-known Landis characteristics are embodied in its construction—ample weight in all parts to resist vibration; spindles carefully and accurately finished by grinding; bearings are adjustable for wear and protected against the ingress of water and grit; flat surfaces are scraped to surface of proof plates; all finished surfaces and bearings are protected; ways of the carriage and bed are self-oiling.

Built in two sizes: No. 24, 63" between centers; No. 23, 39" between centers. Both machines will swing guards in place 16", swing over table 17½".

We have a special bulletin ready which describes them more fully. Ask for it.

Example of Work. Crank-Shaft.

Parts ground, four wrists 1½" diameter, 3" long; 3 journals 1½" diameter, 3", 4" and 6" long respectively. ⅝" removed, time 1½ hours.

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Lang Co., G. R., Cincinnati, O.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
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Sturtevant Co., B. F., Hyde Park.

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Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

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American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

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Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

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Gisholt Mach. Co., Madison, Wis.

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Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
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Messmer Mfg. Co., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
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Syracuse Raw Hide Co., Syracuse, N. Y.
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Franklin Mfg. Co., Syracuse, N. Y.
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Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
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Albro-Clem Elevator Co., Philadelphia, Pa.
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Grant Gear Works, Boston, Mass.
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American Gas Furnace Co., New York.

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Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
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Niles-Bement-Pond Co., New York.
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Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Grinders, Tool
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
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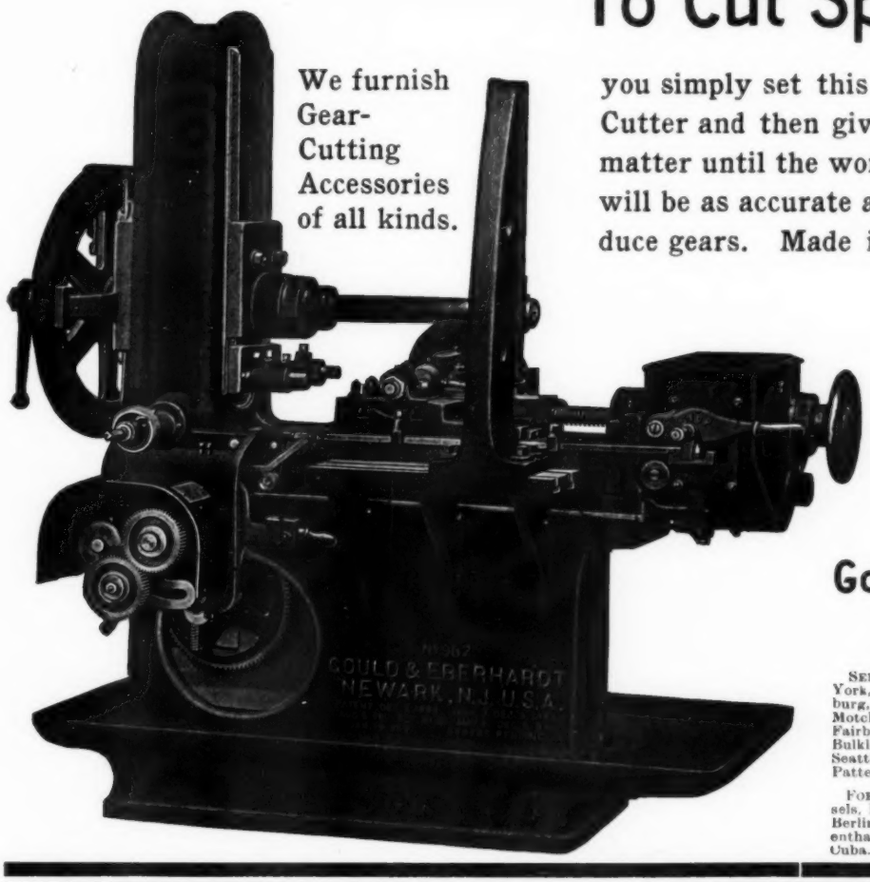

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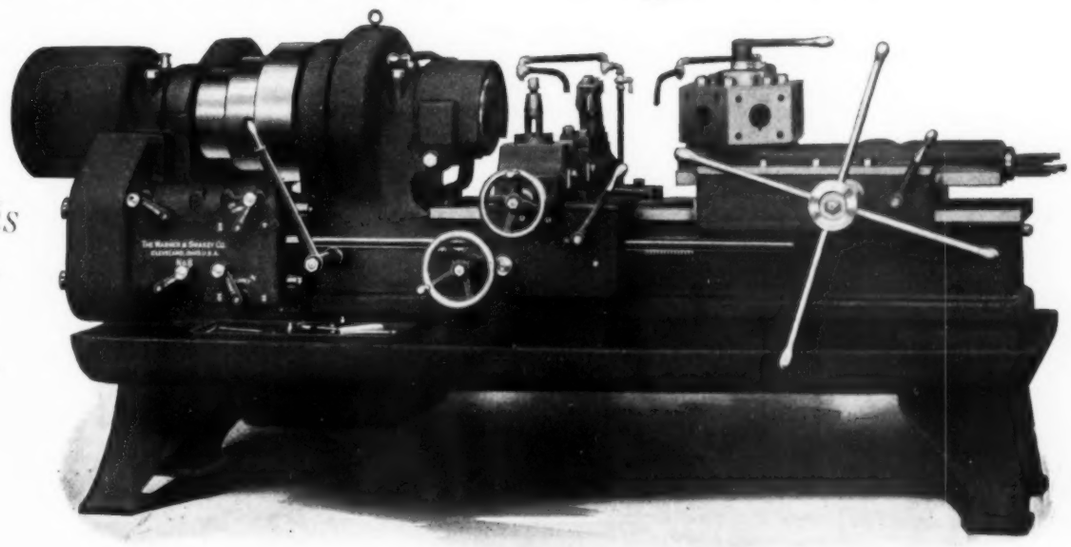

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Electric Traveling Hoists.

We present herewith illustrations of a system of overhead traveling electric hoists that possesses many points of decided interest.

These trolleys and hoists run on the lower flanges of a single I-beam, making it possible to install them in places where it would not be feasible to arrange regular crane runways; the expense also of putting up I-beam track is of course considerably less than that of the regular runway, and the ordinary type of crane

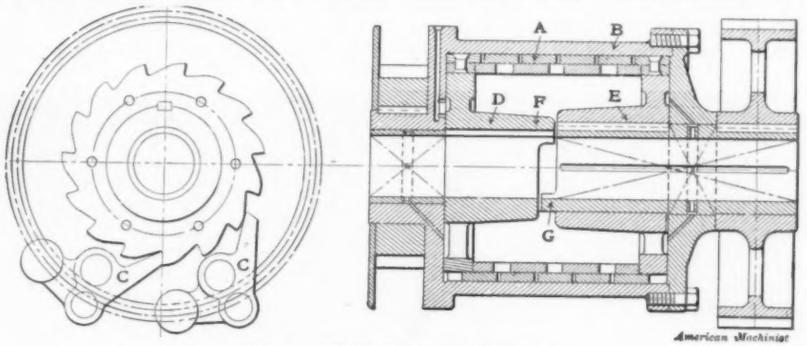


FIG. 1. MECHANICAL LOAD BRAKE.

is frequently too expensive to justify its installation for this service.

These traveling trolleys consist of a crane trolley which can be run off its bridge and carry its load to any point in a plant. The single I-beam track on which the trolley runs can be arranged in an almost endless variety of ways. Spur tracks can be run out at intervals over the floor, beyond the reach of the main bridge. Tracks may be curved to run lengthwise of the floor or to various buildings, railway sidings, etc., at a distance.

For transferring the trolley from one track to another, switches can be arranged. This, however, is not usually done, as the transfer bridge may be moved in line with any of the tracks. The cage for the operator is attached to the trolley, so that the operator is always with the load. An independent motor, driving through a train of gearing, is used for traversing the trolley along the track. Only two conductor wires are required on each track.

The hoists are equipped with two brakes, one a mechanical load brake and the other electric.

The mechanical load brake is shown at Fig. 1. In this brake the force developed by the load on the hook expands the bronze coil *A* against the internal surface of the shell, which is prevented from revolving by the two pawls *C* connected to the trolley frame. The bronze coil *A* is connected to the brake shell *B* through a driven head *D* at one end, and to the motor gear through a driving head *E* at the other end, this driving head being free on the brake shaft. When in action, the forces are transmitted through the shell to the driven head *D*, thence to the coil *A*, which expands against the shell, causing great friction, owing to the multiplication of turns in the coil. As the initial forces are dissipated by the friction of the coil against the shell, the retaining or motor end of the coil requires very little force to sustain the load; consequently a very delicate adjustment in lowering is secured. The pawls *C* are brought into action when lowering by two friction plugs, which also release and keep them out of contact when hoisting. The driven and driving heads are provided with lugs *F* and *G*, so that, should the bronze coil wear down thin enough to be dangerous, the lugs will come in contact with each other and act as a positive clutch, cutting out the friction brake entirely and transmitting the force directly from the shaft to the motor. This also prevents damage which might be caused by the breaking of the bronze coil. This brake is found to be very economical of power and to require practically the same amount of power to lower with full load as with the empty hook.

The electric brake is shown at Fig. 2.

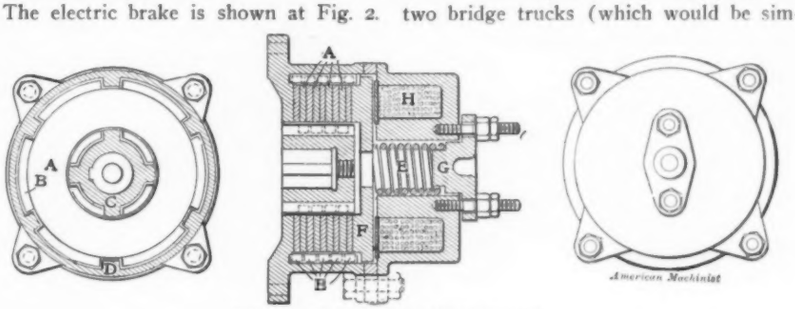


FIG. 2. ELECTRICAL MOTOR BRAKE.

It is attached directly to the frame and armature shaft of the hoist motor, and is entirely self-contained, is dust-proof and oil-tight. It consists of a series of disks, alternately steel and bronze. The steel disks *A* are connected to the armature shaft hub *C*, and the bronze disks *B* to the steel brake casing *D*, which is bolted to the motor frame. The coiled spring *E*, which is forced against the transmitter, disk *F*, by the gland *G* at the end of the magnet *H*, forces the steel and bronze disks together and connects the armature shaft hub positively to the brake casing by means of accumulated friction between the disks.

When current is applied to the motor it passes through the brake coil and motor simultaneously—as they are connected in series with each other. The brake magnet attracts the transmitter disk separating it from the brake disks and releasing the armature hub from the brake casing, thereby allowing the armature of the motor to rotate freely without retardation by the brake; but immediately the current is interrupted by centering the controller, or the blowing of a fuse, etc., the brake magnet becomes demagnetized and the coil spring forces the transmitter against the brake disks and brings the motor to an easy and positive stop. This brake is used to assist the load brake in stopping the load by checking the flywheel action of the armature. It will also sustain the load should the load brake become defective, but is intended to be used for this purpose in case of emergency only.

Figs. 3 to 6, inclusive, show four views selected from a number of photographs taken of the traveling transfer trolley service at the Ramapo Iron Company's Works, Niagara Falls, N. Y.,

Fig. 3 shows the trolley leaving the main girder to run on one of the spurs in the gallery.

This view illustrates the general construction, consisting of a two-motor trolley, with cage directly attached, designed to run upon the lower flange of a single I-beam, the I-beam being either a fixed spur track or the girder of the crane proper. When used in this latter construction, it is necessary to brace it to withstand all lateral and bending moments, so as to prevent the structure from getting out of square upon the runways. This is accomplished by connecting the two bridge trucks (which would be similar to those used on any ordinary overhead electric traveling crane) together by proper structural bracing to keep the two bridge ends square and sustain the I-beam carrying the trolley, making the entire structure self-contained and rigid, and operated preferably by a motor attached to the proper shafting and gearing connected with the bridge wheels in the usual manner of an electric traveling crane.

The trolley, however, is an independent self-contained structure, carrying its own motors and controllers used for hoisting and traveling, also controller used for

operating the bridge motor, these controllers being conveniently located in a structural steel cage of sufficient size to comfortably contain the operator, who always travels with the trolley and has its various motions under complete control.

This trolley is equipped with swiveling trucks to enable it to run around curves and over switches, as shown at Fig. 5, and is at liberty to leave the transfer bridge at any desired point and travel upon a fixed spur with its suspended load to any desired location. Upon returning to the transfer bridge the entire structure operates as a three-motor crane.

The system installed at the Ramapo Iron Works is ordinarily used to serve the floor work in the main bays of several buildings, each transfer bridge being capable of operating (when traveling upon a permanent fixed runway within certain fixed limits and utilized within these limits) the same as a regular three-motor electric traveling crane, as shown at Fig. 6. In addition the trolleys of the cranes are also used to transfer the finished work from the first floor to the second floor of the lean-to—shown at Fig. 4—and to serve parts of the lean-to, which has no second floor, the trolley transferring the work from the main bay after the crane is lined up with the communicating I-beam system of fixed spur tracks on the second floor or lean-to, and if run off on to the fixed spur system of tracks carrying the work to any part of the floor.

At the end of the building a crane travels over the railroad tracks and communicates to a system of fixed spur tracks, which are at right angles to the building, making it possible to load and unload a number of cars on the railroad siding without switching.

The arrangement is also such as to enable the crane to be connected with the yard system of fixed spur tracks to run the trolley out around the curves to any part of the stock yard, thereby taking the material from any part of the stock yard (covered by the fixed spur tracks) to any part of the shop without transferring the load from the hook. The crane or transfer bridge is fitted with interlocking switches and stops, locking the crane in line with the spur track, the transfer bridge having at each end a positive stop, which prevents the trolley from running off the bridge, except when released by the operator, so as to eliminate the possibility of the trolley running off the bridge when not connected with the fixed spur track or when the transfer bridge is traveling and carrying the trolley.

The electrical wiring is so arranged that when the trolley leaves the crane all connections to the bridge motor are interrupted, which makes it impossible for the crane to run away from the spur track while the trolley is off the crane. The wiring of the spur tracks is simple and the same as any ordinary runway wiring. It will be perceived that by this arrangement it is comparatively easy to arrange what is virtually a complete system of overhead, single-rail tracks, in which system the traveling cranes, if such are included, perform, in addition to their ordinary functions the office of transfer tables. There may be as many of these trolleys as may be required; the system is readily extended at any time to meet growing demands upon it, and any trolley may pick up and carry a load from any portion of a works to any other portion. The proportion of dead weight to load is reduced to the minimum, and the system seems admirably adapted for almost any industrial purpose. The maker is the Niles-Bement-Pond Company, 111 Broadway, New York.

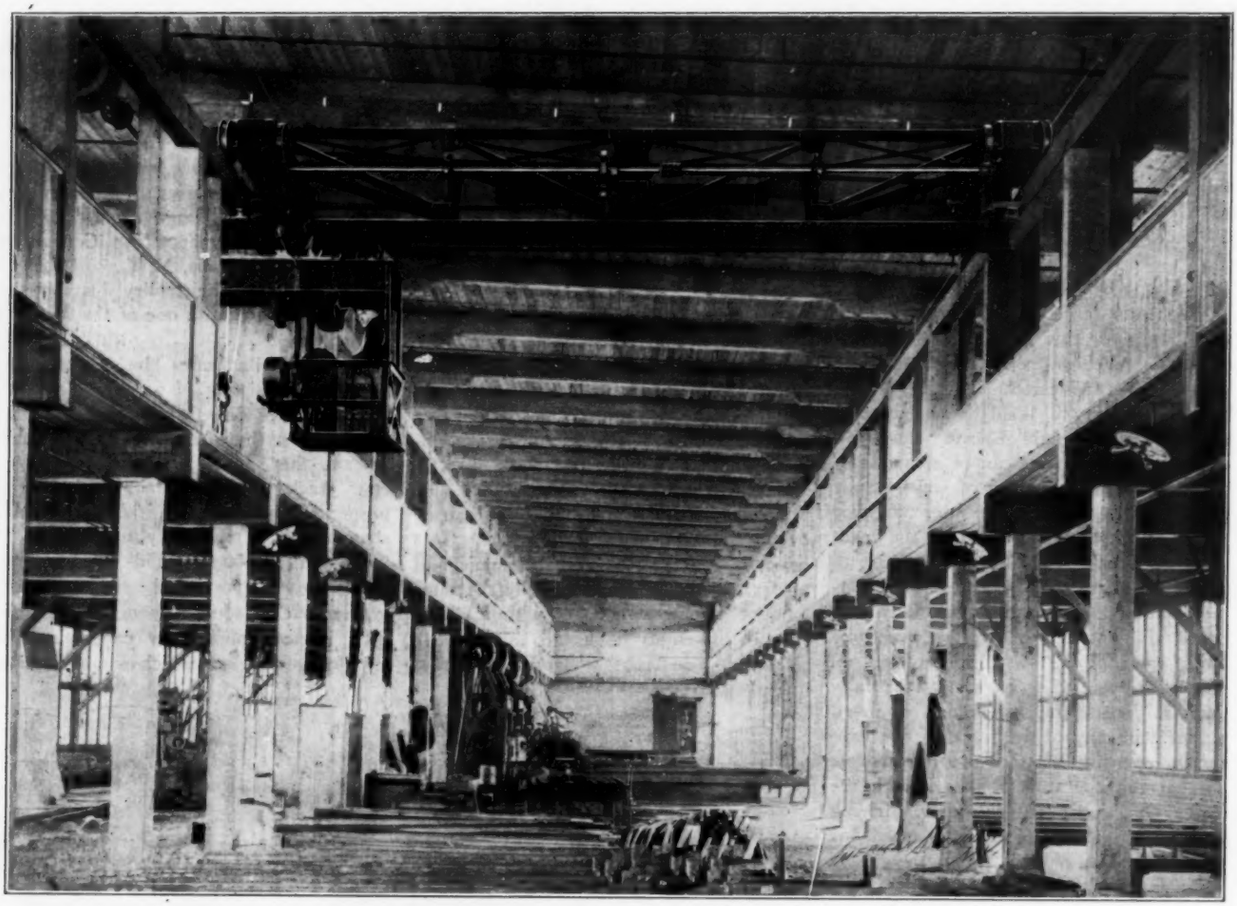


FIG. 3. TROLLEY LEAVING THE MAIN GIRDER TO RUN ON ONE OF THE SPURS.

It may be possible that water-storage plants will some day take the place of forests and enable water powers to be utilized that have long since fallen into innocuous desuetude, because many streams that now flow spasmodically formerly flowed steadily.

Some Reasons Why Good Men Are Scarce.

BY I. N. EARNEST.

Frequently in our experience, and through personal observation and printed comment on the matter, we are compelled to a realization of the seeming dearth of really good and competent men in the mechanical field to-day. This does not lessen the fact that plenty of good men exist, but do not have the opportunity to put themselves in evidence. We frequently find them holding some minor position of more or less importance or as a unit in the rank and file, which fact in many places acts as a deterrent or preventative to their ever rising above mediocrity there. We frequently hear it remarked that good men are not looking for positions; or, there are too many opportunities for good men, etc. I have often wondered, upon hearing such remarks, what constitutes some employers' standard of good men. I have seen some cases that set really good men to thinking.

I took charge of a toolroom at one time with a certain manufacturing concern having a man in that department who had worked as toolmaker for the entire period of his servitude (fifteen years). During that time he had worked under seven different foremen, and was the oldest man in the employ in that department; and the success of the different foremen was, in a large measure, due to that man's knowledge of the plant, the work and things in general. He was willing, obliging, conscientious and a hard worker, and always on hand. The man had a good education; his shop mathematics were good, and he had about as good sound common-sense as any man I ever saw. He was in every sense of the word qualified to take charge of that department or to hold any position of responsibility within limits. As I always had a weakness for getting at the bottom of things, I made it my business to get next to the reasons for keeping that man down.

The result of my investigations could be summed up about as follows: He was a good man as a workman, and owing to his obliging characteristics and ability to do a lot of work and lose little time, he was considered an indispensable factor; and besides, he was a big help to the other men. If he was put in charge, he would become a non-producer, and the company would lose on the transaction. He was too easy-going to be in authority. This latter really was as strong a reason as any for keeping him down. The truth of the matter was, the man had repeatedly tried to better his condition with the concern with but little success. He kept on hoping and believing that, in time, merit would bring its reward. His domestic responsibilities kept increasing, rendering him more and more dependent as time went on, until he finally lost ambition. Later the opportunity presented itself whereby I was able to further his interest and took a chance on him (so to speak). I am pleased to know that to-day he is superintendent of a progressive manufacturing concern, where he has risen from toolroom foreman.

This may contain a moral or a lesson that some employers might take and benefit thereby. Narrow-mindedness, prejudice and a tendency to be controlled by superficial observation, show up, invariably on the wrong side of the balance sheet. A question or two in point: Why do not employers try and keep good men when they have them? Why do they maintain an indifference of demeanor toward their good men and antagonize, discriminate against and treat them from a common level, and generalize in their attitude toward them? Good men will not stand for these things any longer than they are obliged to, and many not that long. I am

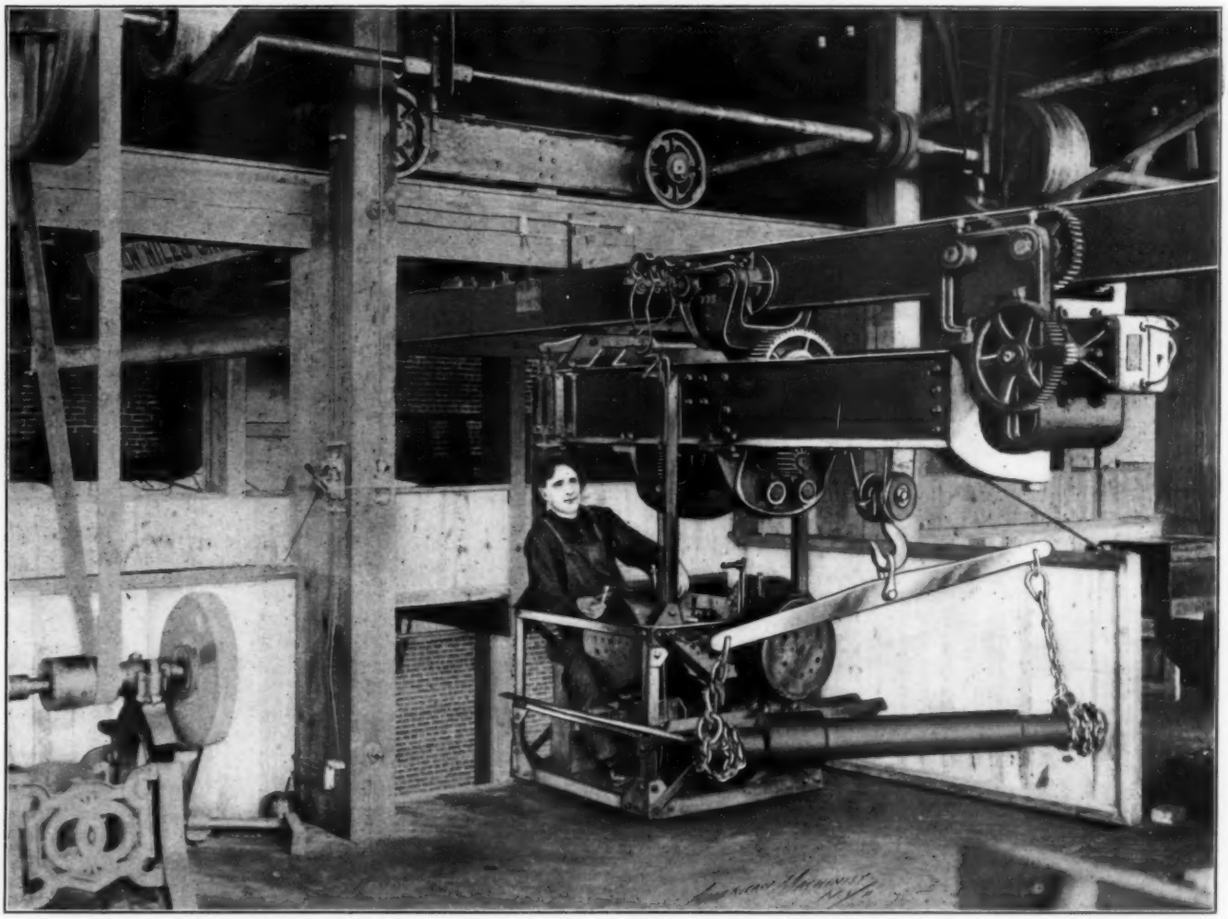


FIG. 4. TRANSFERRING FROM THE FIRST FLOOR TO THE SECOND FLOOR OF THE LEAN-TO.

pleased to know of methods and means being adopted by the management of several progressive manufacturing concerns, whereby they can assure themselves of the qualifications of their employees, and as a consequence have enacted shop legislation and system whereby both parties are benefited.

Some employers insist on having technical men only, holding that the technical graduate is going to fill in to far better advantage than the "self-made" man. Probably this is true in some cases, but I can say from personal experience of a number of years with many cases, that the self-made man who has mastered the technical as well as the practical end of the business through his own exertions has proved by far superior to the purely technical graduate.

These deductions are based upon the practical money-getting, cost-reducing and successful features of the argument. An other factor largely instrumental in preventing the competent man from getting in evidence is the mechanical bluffer. He will make his appearances oftener in the shops than he should in jail, and by gift of gab, a brass front and unmitigated self-conceit and assertiveness succeed in hypnotizing the employer and securing a foothold, to the detriment of good men in general, and holding to it till time tells the story and he is given unlimited vacation. A few experiences of this nature engender skepticism and loss of faith on the firm's part in humanity in general (excepting in themselves, possibly), and undoubtedly they are justified in a measure, after having had such poor results trying out a number of those alleged mechanics who have come with a pocketful of testimonials given as a kind of a sop in order to get rid of them as easily as possible by some less scrupulous concern.

Since we cannot always tell, we keep on hiring and the trying-out process goes on till the desperation period is reached, which frequently results in an inspection of the "rank and file" for an eligible man to fill the position, and it is surprising how many times the man has been found. He has, in fact, been under our noses all the time. Remaining in obscurity is as often at this day the man's own fault as well as the conditions surrounding and conspiring to keep him down. He must wake up to the fact that his success depends in a large measure upon his own initiative and self-confidence, which he must assert, but in a modest and unobtrusively convincing manner. He must be able to show results as well as to show by carriage or deportment that convinces he *can* make good, if he is given the opportunity.

I recall a story told me some time ago showing wherein the man was justifiably denied the opportunity; in fact, I have often wondered what he would have done with it if he got it. He appeared upon the scene in answer to an "ad." for a high-class, expert toolmaker. His personal appearance, as far as dress was concerned, was calculated to impress. He looked too beautiful and artistic to associate with ordinary toolmakers, and speculation was ripe among the boys as to whether "it" would be kept in a glass case or not, in case "it" was engaged. He was shown around the department, and the various machines and tools were pointed out, a few of which he condescended to notice by a wise look or a motion of the head, which left you in doubt as to whether it was approval or disapproval. He was finally brought to the ——— milling machine, which had recently been installed. He shook his head and remarked he did not like the —— milling machine. The foreman was rather surprised, and remonstrated, "Why do you not

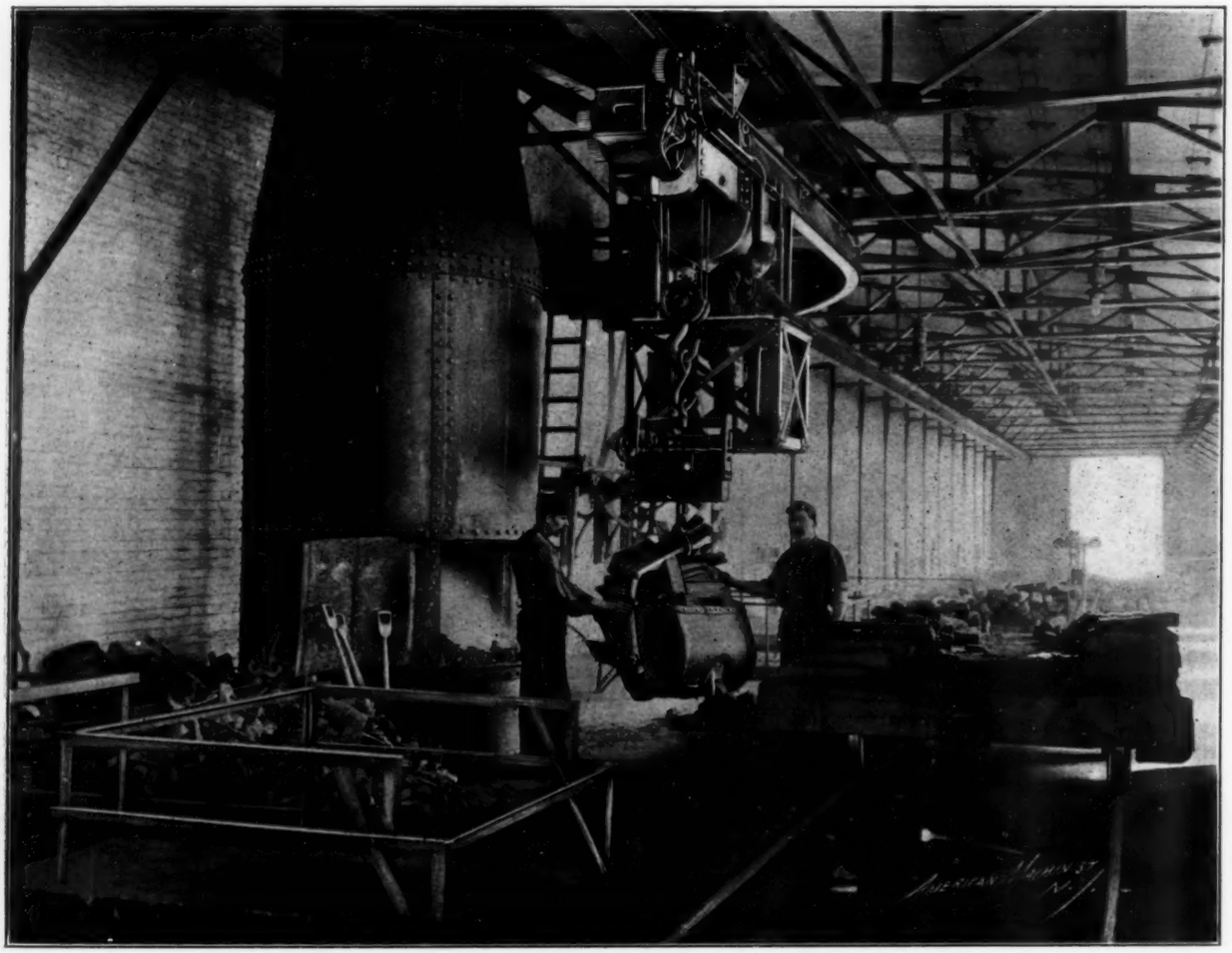


FIG. 5. SHOWING CURVED TRACK AND SWITCH.

like that machine? We consider it the standard of machine design and would like to know your objections." Upon being pressed he finally agreed that he did not like the "shape of the handles." Well, he was told they were pleased to have met him and would communicate with him later. I do not know whether he has ever changed his mind concerning the shape of those handles or not.

The man must needs realize that he who can fill the bill and deliver the goods is *the* man. Aggressiveness is a characteristic he must cultivate. Not the kind that is going to draw the ill-will of his associates or men upon him, but a forceful, confident delivery and deportment that carries the conviction that the man knows what he is talking about and knows how to do it and how it should be done. This man in the right place will prove his value, and as a rule be valued accordingly. It is rather unfortunate that the practically proficient man to-day is handicapped to the extent that he is on account of the prevailing tendency to favor the technical graduate. I do not mean to put myself on record by implying that the technical man or his qualifications should be considered or thought less of in any respect. What I do want to say is that there are plenty of really good, "self-made" men who have mastered the technical end of the business as well as the practical and will qualify.

If some employers were not so biased upon the subject of "technical graduates" only, there would not be the want of good men that is so frequently brought to our notice. I have known some good men who were purely technical graduates without any field or shop training, and some others who could not do anything, think or speak anything that was not technical, and were, in fact, so thoroughly inoculated with technics that they became "obstructionists" pure and simple. It is a pleasure to me to know of some shops wherein the system, personnel and the atmosphere are conducive toward bringing out the best in the man, and where perception and progressiveness enough are displayed to acknowledge the practical man by according to him his sphere and opportunity, and noticeably to the benefit of both parties in the majority of cases. It is to be regretted that the ethics of much of the system in many shops, bearing upon the employment of skilled and expert men, are prohibitive, dampening and discouraging to such a degree as they are to the self-made man. He feels and knows he can qualify if given the opportunity. He knows the requirements call specifically for a technical man. He knows from his own experience (maybe with that particular plant) that something more than "technics" is sadly needed. He knows that he has not got an M. E. affixed to his name, but that he is both practically and technically qualified to manage or superintend that plant. If he has the courage to go forward and state his case, his qualifications and eligibility, he is either ignored or turned down.

Many good men in the market to-day for positions have not had their opportunity to make their record, and as they must exist in the meantime, they keep changing and seeking that which materializes now and again. You may have them in your employ. What means do you take to ascertain their qualifications if you are one of those who are crying for "good men"? If you have ever satisfied yourself as to their merits, how do you treat them? Do you consider the man as a machine

FIG. 6. SERVING PLANERS IN ONE OF THE MAIN BAYS.

that requires just so much oil or grease to keep it moving, or do you consider he is a man the same as yourself, and whose best efforts can be obtained by manly and considerate treatment? How much of a premium do you, as an employer, put on honesty, ability and faithfulness? If you have reason to complain of the lack of good men, it is your own fault. As it is human to err, any good man will make mistakes. We cannot expect to attain perfection this side of heaven, and your method and amount of condonement or condemnation have a great deal to do with your profit and loss in such cases. I have known of men leaving work they were deeply interested in and took pride in getting the best results out of because the personnel of the plant was inharmonious, the atmosphere innoculated with jealousy, prejudice and distrust, a penny-wise and pound-foolish conservatism, with its attendant train of evils always in evidence, the whole situation engendered by a superintendence that had for its religion bluff, impracticability and an overwhelming desire to impress with a personality mentally and practically incapable of living up to the pretensions. Good men refuse to become acclimated to such conditions, and as soon as sensed they prepare to move. If you have plenty of good men in your employ it speaks volumes for your manageemnt, and I would advise those who complain of the lack of skilled or competent help to emulate the personnel as well as investigate the methods and system of some of those progressive and successful manufacturing establishments who always have plenty of good men. I would also advise giving the man who is practical as well as technical, and can mix his theory with practical common-sense, some encouragement, an opportunity, a chance to develop or to show what is in him

A Sectional Trimming Die.

BY D. SIGNER.

The trimming of tool-steel blanks as here shown, 5-32 inch thick and 7/16x2 5/16 inches over all, to very accurate dimensions requires press tools of accurate and reliable construction and also tools that may be easily and cheaply repaired in case of any part becoming defective. A set of tools of this class is here shown, the tool-steel blank trimmed by them being illustrated in the "before and after" shapes in Fig. 1.

The blank to be trimmed is left square on the ends, is milled all over, has a channel milled in both sides at *A* and *B* respectively, and has a section punched out at *C*. These trimming tools notch the piece at *D* and *E* and trim the ends to the symmetrical shapes indicated.

In view of the nature and thickness of the stock to be punched, the accurate dimensions demanded in the finished product, the fact that thousands of the pieces were required weekly, and the low piece-work price to be paid for the operation (2 cents per hundred) it was thought economical to design a set of tools cheaply and easily repaired, which would insure the interchangeability of the product, and lastly be rapid producers.

F is a machine-steel bed or bolster in which all the die sections and working parts proper are fastened. *H, I, J* and *K* are the four hardened, tempered and ground tool-steel die sections, which act to trim or to shear and notch the ends *E* and *D*. These sections are let into accurately machined channels or seats in *F*, are fastened by fillister-head screws (as shown in the plan) and are side and end-banked against set-screws *P, N, Q* and *O*. *LLLL* indicate narrow slots milled into the base or holder *F* to the depth shown, and with their inner sides an exact distance apart, thus serving as set edges and locating or banking surfaces for the ends of the die sections *H* and *J*. The center of *F* at *Y* was worked out to a clearance size for the trimmed blank to drop through after punching.

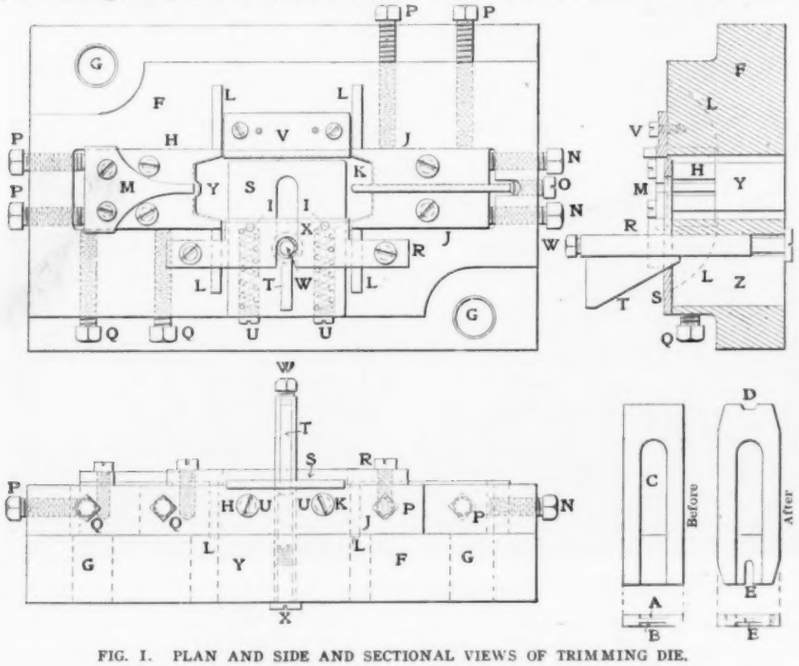


FIG. 1. PLAN AND SIDE AND SECTIONAL VIEWS OF TRIMMING DIE.

The other parts of the die which require mention are the reciprocating slide or pad *S*, upon which the work rests previous to the descent of the punch, the locators *V* and *R* for locating the work edgeways, and the arrangement for working the slide back and forth by the action of the press ram.

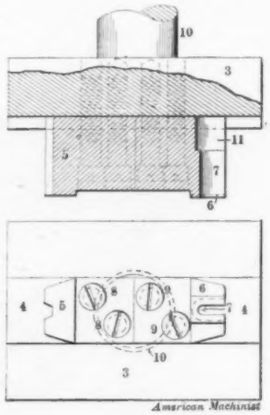


FIG. 2. SECTION AND PLAN OF PUNCH FOR TRIMMING DIE.

The vertical cross section of the die shows the construction of the various parts, and also how the slide works, while the plan shows the springs *I I*, the inclined-faced actuating surface *T*, the adjustable set-screw *W*, and the headless spring-adjusting screws *U U*.

The upper or punch section of the trimming tools is illustrated in Fig. 2. *E* is a machine-steel stem or holder, of which 10 is the stem proper; 44, a square-bottomed channel milled down its entire face, in which the two punch sections 5 and 6 are fastened by four fillister-head screws.

The tools being set up in the press, and the set-screw *W*, in *T*, being adjusted so that the face of the punch slide will come in contact with it and cause the slide *S* to move back out of the way before the punch enters the die, a blank is placed on the pad *S* by the operator and located between plates *V* and *R*, and endways against end stop *M*. The press being then stepped the punch descends, the face of the ram strikes set-screw *W* and forces cam-stud *T* downward, thereby causing pad *S* to draw back from under the work and leave a clear working space for the punch to trim the ends and force the part into the die. Upon the up-stroke of the press ram the springs *I I* cause pad *S* and the cam-stud *T* to resume their former positions, and the die is ready for another blank.

A Swiss Measuring Machine.

BY DR. ALFRED GRADENWITZ.

A precision measuring machine, shown in Fig. 1, is just being brought out by the Genevian Society for the Construction of Physical Instruments, of Geneva, Switzerland, the machine warranting an accuracy as high as 0.0005 mm.

The frame rests on three neutral points, the plates being adjusted with great accuracy. The distinctive feature of the new machine is the immobility of the reading microscope, while the standard scale is made movable. Experience, in fact, goes to show that any errors due to a variation in the plane of the scale are of less importance than those resulting from a corresponding difference in inclination of a movable microscope. This is shown in the line-drawing, Fig. 2.

The screw has a pitch of ½ mm. and is provided with a special device for compensating for wear. There are two immovable microscopes, one for taking readings on the standard scale and the other for reading the zero or contact mark. In order to obtain a uniform pressure on the contact faces, one of the spindles is made movable, its pressure being maintained constant at one point by a spring. This point, marked by a line on the spindle, which at this place is specular, is so located that on the measuring faces being in contact the line lies exactly beneath the corresponding microscope, also called invar, the coefficient of thermic expansion of which is exceedingly small, and is divided into millimeters on a reflecting surface; a coarse external scale indicates which is the millimeter line seen in the micrometric microscope. This standard scale can, of course, be divided into inches and parts of an inch.

There are devices for properly placing the objects to be measured in the machine, and regulating their height and lateral position. A good point is that any object can be measured by means of the micro-

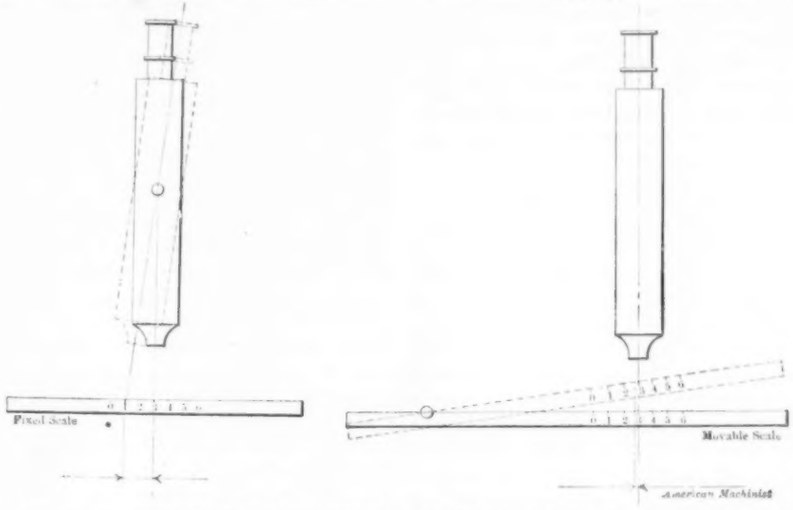


FIG. 2. SHOWING ERROR DUE TO INCLINATION OF MICROSCOPE AND TO INCLINATION OF SCALE THROUGH SAME ANGLE.

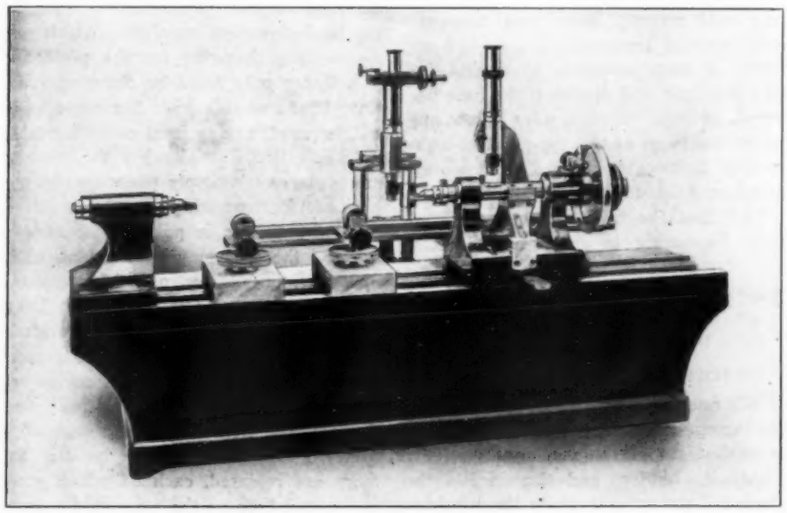


FIG. 1. A SWISS MEASURING MACHINE.

while the zero of the standard scale is located below the reading microscope.

After the machine has been so regulated, readings may be taken either by means of a micrometric reading microscope or by means of a precision screw, the drum of which has 500 divisions, each of which corresponds to 0.001 mm. One division on the micrometer of the microscope also will give 0.001 mm., it being possible to read 0.00025 mm. by either of these processes.

The standard scale is of the nickel steel, metric microscope and the standard scale without using the precision screw, so as to eliminate any error due to the use of the screw. The mark of the constant contact is checked optically and not by mechanical means.

The requirements for success in a calling are deserving of a more respectable phrasing than "tricks of a trade," for this suggests trickiness, which is an abomination in the sight of an honest workman. —*Woodworker.*

The Use and Construction of the Adding Machine.

BY FRED W. M'ARDLE.

To the average mind, the adding machine is something of a mystery, and considerable of a wonder. This is true not only of the general public, but to a great extent even with the mechanic, yet to-day the manufacture of the adding machine gives employment to hundreds of men and boys, many of the former being skilled and highly paid mechanics. Go into any Chinese laundry, and you will see somewhere, a frame with cross wires, on which are strung wooden balls. This is the shwapan or, as it was known to the Greeks and Romans, the abacus, which was the first adding machine, of which the origin is "lost in antiquity." The adding machine as it is known to-day, is the product of the American activity, which is always on the lookout for a short cut.

EARLY ADDING MACHINES.

Perhaps twenty years ago, a machine was built by a priest in Kentucky, which is said to have worked well, but it was never perfected, and was lost sight of, mainly because the inventor was ahead of his time.

Many original minds have been at work on the problem, and while there have been many machines made, some of unique construction, it is only within the last ten years that machines have been constructed that could be called practical. There have been and are various machines for calculation, distinct from the adding machine proper, but it is of the latter that this article treats, as space will hardly allow of even an adequate treatment of this type. St. Louis is generally considered the birthplace of the adding machine, and it was there that it first became a practical article. Much costly experimenting was done before this was accomplished, and much difficulty was experienced in even getting a hearing with

concerns that now find it indispensable in their business. Like many another labor saver, while hard to introduce, when once given a fair trial, it not only became a convenience, but a necessity. While machines of the lever type were being built by two or three companies in St. Louis, independent work was being done in Chicago on a machine in which the adding was done by pressing the keys only, and later on a machine of the same type was made in Providence, R. I. Still later, in Detroit, Mich., Sheboygan, Wis., Chicago and New York, other machines were made, all of which were lever machines, and which were practical, varying in detail, each having its special claims to superiority. At this time, the adding machine is as much a necessity in many lines of business as the typewriter.

USES OF ADDING MACHINES.

In one department store in Chicago, there are over one hundred in use, and in banks they are almost universally used. It is claimed that there are over 23,000 machines in use in this country, in addition to those in use in Europe. Inquiries for machines and agencies are received from all over the civilized world, and the supply does not equal the demand. The adding machine field is not confined to banks and large stores, nor is it confined to large cities, as machines are sold in communities with as small a population as 400, as shown in reports of sales.

Wherever amounts are to be added or accounting is to be done, the adding machine finds a place. This is true not only in plain accounting, but in time keeping, lumber and leather measuring, and various other lines, special machines being adapted to the various requirements which, while in the main standard, are modified to suit each case. Machines are made to add quarters, thirds, eighths, twelfths and sixtieths.

There are also the so-called "split" machines, which have two or more columns, one or all of which accumulate. These are used in railroad offices, insurance offices and other places where it is desired to give items only, as well as items and amounts. Almost any reasonable modification may be made if there is sufficient call for it, and as the machine becomes better known, these calls become more varied. One of the companies in Chicago, has had recently a call for a machine, which should be capable of taking a sheet 25 inches wide, and printing fifteen-figure items, and to be capable of dividing the item, so that any series of the fifteen would accumulate, while other series would only register, and be capable of changing these combinations at will. This was called for by a prominent railroad company, and is by no means a freak machine.

This would seem to be about the limit, but one other case came up at the Chicago show of office appliances, that goes still further, a call being made for a machine that would be an adding machine, yet capable of printing any word or name of a commodity, at the time the item was printed.

This is distinct from the typewriter adder, and might be called the adder-typewriter, as the principle would be reversed. This description would not be complete without a brief mention of the typewriter-adder.

THE TYPEWRITER ADDER.

On this type of machine over fifty patents have been granted, yet it can hardly be said to be beyond the experimental stage. One or two have been put out, and have given excellent results, and without doubt machines will be perfected that will prove a commercial success. At this time there are at least two of these machines built that show perfect working results, but they have been on the market but a short time, and as the parts are necessarily very delicate, it can hardly be said that the machines are perfect until the wearing qualities have been tested by time. Generally speaking, the typewriter-adder consists of an accumulating attachment for use with the typewriter and fastened thereto. This attachment is necessarily compact and must not interfere with the regular operation of the typewriter, yet be capable of immediate use in connection with whatever work is being done. The great field apparently for this type of machine is in billing and listing with names, items and amounts carried without separation.

There is unquestionably a demand for such a machine, and doubtless the time has arrived, or will soon arrive, when one or more machines of this type will be commercially a success. There is, however, a distinct field for the straight adding machine, and the field seems to be constantly increasing in size, and it would seem that there is room enough for all the good machines that are now on the market, and likely to be on the market for some time to come.

PRINCIPLES OF ADDING MACHINES.

While one can see the operation and results accomplished on the adding machine, the mechanism of the machine is wholly or partially hidden, and therein lies the apparent mystery; yet while the mechanism is complex, the principles involved are quite simple, most of the mechanism being composed of duplicate parts, or parts introduced to make the machine as nearly "fool proof" as possible. This is not only necessary for the inexperienced operator, as even the experienced operator will sometimes lock the machine if it is not protected at all points.

While the machines built by different concerns differ in construction, the best known machines may be divided into two classes—the listing, or printing machines, and the non-listing. Both classes are, however, based on the same principles, and both have their distinct fields, which can hardly be said to overlap, though there are cases where either may be used with satisfactory results to the user.

A description of the main points of the first class will, in the main, describe the essential parts of the second. The machine has a keyboard, similar to the typewriter, with nine rows of keys, each row running from 1 to 9, the 1's being in front of the machine. One machine on the market, however, departs from this rule by having one set of keys running from 1 to 9 and another set of keys for locating the figures of the item, whether in the million column or the units column, and automatically locking when the figure in the units column is reached, being otherwise essentially the same in principle. In the nine-row machine the units are at the right, then the tens column and so on to nine places or the million column, which for most purposes gives sufficient capacity.

In operating the machine the proper keys are pressed and remain depressed until the lever at the right is operated; this records the item on the paper, and on the return of the lever the keys are released and return to normal position ready for setting the next item. Should a wrong item be set, it may be thrown out by pressing an "error" lever or key, which returns all keys to position, without making any record or accumulation.

In one or two of the latest machines, the keyboard is so arranged that the pressure of one key releases any other key in that particular column, which saves the need of throwing out the whole item if a figure only is to be changed. With a keyboard of this kind the error key is seldom used, as any item may be changed to any other item having the same or more places by simply pressing the right keys. After pressing the keys for the item, the handle is pulled, and racks or arcs, as the case may be, carrying each a line of figures, from 0 to 9, are moved, and projections strike a stop set by the depressed keys. These stops permit the type bars to move to positions corresponding to figures on the keys, the corresponding types coming to the printing line of the paper platen. Near the end of the forward movement of the handle, hammers are released, each of which strikes one of the type on the printing line, which registers the item on the sheet or paper roll.

Each of the racks spoken of engages with a pinion carrying a wheel spaced and numbered from 0 to 9. When the handle is pulled, the rack is disengaged, the pinions being simultaneously locked in position; the racks move to positions set by the keys, and, on the return stroke of the handle, drop into gear, the pinions unlocking, and revolving number wheels the number of spaces corresponding to the figures in their respective columns.

These number wheels show, through an

opening in the case, the accumulated amount in the machine. The mechanism for carrying from one wheel to another, when adding above 9 on any wheel, is one of the most delicate parts of the machine, as well as of prime importance, for anything which interferes with the perfect action of this part of the machine, not only shows the wrong accumulation on the number wheels, but also causes the wrong total to be printed when all items are registered. This carrying mechanism varies in detail with the different makes of machine, but is substantially the same in principle. It is in general accomplished by a pin or lever attached to each number wheel, striking a lever which is loaded automatically. By tripping these levers when carrying from 0 on one wheel to 1 on the wheel to the left, the latter is moved one space forward, the rack being separate from the rack bar, and when the machine is at rest, being normally under spring tension, which allows one tooth movement when the carrying lever is tripped. The pinions and racks being in engagement at this end of the stroke, the carrying is thus accomplished. When a total is required, a spacing stroke is generally taken, and a total button or lever operated to change the mechanism of the machine, so that the racks remain in engagement with the pinions during the first part of the stroke, moving until stops on the number wheels engage with a bar or its equivalent, at which time all the number wheels indicate 0, and the type bars have moved through the proper number of spaces to bring the proper type to the printing line to print the total. On the return stroke, the racks and pinions are disengaged, and when the machine is at rest, it is clear of all accumulation. Should a footing be required, and the same carried to the top of the next column, the same process is gone through with for the first half of the stroke, but before the handle starts on the return stroke, the mechanism previously set is thrown out, which leaves conditions in the machine the same as when an item only is registered. In the non-listing machine, no handle or lever is used, the keys in the keyboard acting direct to accumulate.

SPEED OF OPERATION.

On the first type of machine, in a record test, 500 items of various amounts were listed in a little over nine and one-half minutes, and the same number of items were added correctly on a non-listing machine in less than five minutes, where a record was not required. Both of these examples were by experts, but thirty to forty items per minute may be readily attained. While primarily adding machines, subtraction may be accomplished by addition; as, for example: Given 3,684, to subtract 2,167. The first item is registered, and to it is added the difference between 2,167 and 999,999,999, which is 999,997,833. This gives the correct subtraction preceded by 0's. Multiplication is performed by repetition, and for this the keys are locked down during the repetition—in some of the machines by an extra "repeat button," or by a reverse movement of the error key; while in the non-listing machines the items are repeated by again depressing the proper keys. Division can also be done, but the process is complicated, and not feasible for ordinary use, and for that reason is hardly worthy of explanation in this article.

When it is considered that in the different machines now on the market, there are from 1,600 to 4,000 parts, it can be readily understood that the adding machine is an intricate piece of mechanism, and that the parts require great accuracy in manufacture, if they are to be made interchangeable. Expensive tools, dies, jigs, test tools, etc., are necessary, and while the first cost of these is high, the saving and greater accuracy resulting amply pay for the cost, and a machine is produced that can be depended upon to give accurate results and to last many years after it has paid for itself.

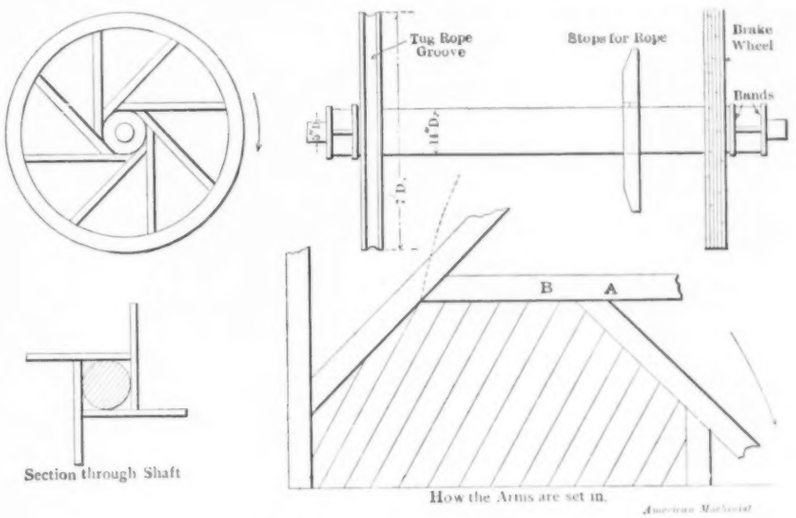
When a splinter has been driven into the hand it can be extracted by steam. Fill a wide-mouthed bottle nearly full of hot water, place the injured part over the mouth and press it slightly. The action thus produced will draw the flesh down, and in a minute or two the steam will extract the splinter, also the inflammation. —*National Magazine.*

At the Montreal shops of the Canadian Pacific all driving-wheel tires are turned in one 90-inch lathe. After the wheels are set in the machine and the turning begins, a helper paints the axle journals with white lead and oil. The jar of the lathe renders it possible to discover cracks which are not revealed by any other method of inspection.

Bull Wheels and Tangent Arms.

In a letter forwarded to me lately by the editor, a reader asks to be informed as to why the arms in bull wheels are put on at a tangent to the shaft instead of radially. He thinks this a matter that might interest others besides himself, and in view of the faith he has shown in my ability, I cannot do less than the best I can.

Thinking there may be some readers who do not know wherein a bull wheel differs from a bull lathe or a bull gear, I send a little sketch. The small part on each end of the shaft is an iron bearing. The sizes marked on will give a general idea; they will show also that the sketch is not made to scale. These bull wheels are made of different sizes to suit the varying conditions and the notions of such things held by different people. The shaft, arms and rims are of wood, and the entire wheel is put together with spikes. The gudgeons that make the bearing at the ends have wings on them. After they are driven into place two iron bands are shrunk on each end over the shaft to bind them firmly into place.



THE BULL WHEEL AND ITS TANGENT ARMS.

The bull wheel is a part of an oil-well drilling outfit. It is placed at the side of the derrick farthest from the engine, and is used to coil the cable on. This cable is from two to two and a half inches in diameter and long enough to reach to the bottom of the hole to be drilled. Around here that is about one thousand feet.

A cable called a "tug rope" runs in the groove in one side of the wheel and turns it when the tools are being pulled from the well. An iron band fits over the wheel on the other side and makes a brake for controlling the motion when the tools are being lowered into the hole. The tools and the water-soaked cable may weigh several tons.

The pull of the tug rope is in the direction of the arrows, and the strain,

when the tools are running down and the brake is applied, is in the same direction, although the motion of the shaft is in the opposite direction.

It will be seen that by pulling on an arm, say, *B*, so as to tend to turn the shaft in the direction indicated by the arrow, the tendency is to tear it loose from the shaft; and to do this it would have to move with the point *A* as a fulcrum, the end moving as shown by the dotted line, or it would have to slide forward. The arm that laps over the end prevents it from swinging, and the rim keeps it from going outward. It will be seen that while the construction is a very simple one, it is also a very strong one, and it is also a cheap one to make.

I do not know of any bull wheels being made now that have the arms put in in any other way, although upon inquiring among some of the "oldest inhabitants," I am told that there was a time when they were mortised in like the spokes are in a wagon hub. That way has been entirely abandoned, and I think it is simply a case of the survival of the fittest.

There is no question but that the shaft in the way now used is the strongest, as it is not cut away as it would be if it were mortised. If anyone has any doubt about strength being of the highest importance, he should stand before one of these wheels when it is making 250 turns and shaking the whole rig, and then think that it has been exposed to the weather and all sorts of uses for an unknown time and in the hands of all sorts of men. After thinking of the load it is carrying and seeing the sudden way the speed is checked, one is tempted to move out of line even if the wheel is a new one.

When it comes to the question of cost of manufacture, it also is all in favor of the present style. The arms can all be finished at the mill, and it is only a job of sawing. A good sound log, of oak, generally, dressed down to an octagon at each end, the gudgeons driven into slots that can be made with a saw and a chisel, and the center turned, or otherwise dressed off until it is roughly round, and the shaft is ready for the arms, which only have to be spiked into place. The rims are made from cants sawed out at the mill to the shape wanted, and it is a simple job to nail them together.

The retail price of a single wheel of about the sizes given is at present about $27, and as far as I can discover, the only reason that the wheels are made as they are is because no one in this section knows how to make a better one of some other design that can be sold for less money. Even as good a one that could be sold for less money would find a place.

Some of the former wheels used to have more lumber in them, and most of it was in the rim, where the centrifugal force would get hold of it the worst, and it used to be much more common to hear of wheels "blowing up" than it is now, although now the drilling is done more rapidly.

I hope this will cover the points of interest. If it does not, and I can get a line on the other points, I will try to reach them.

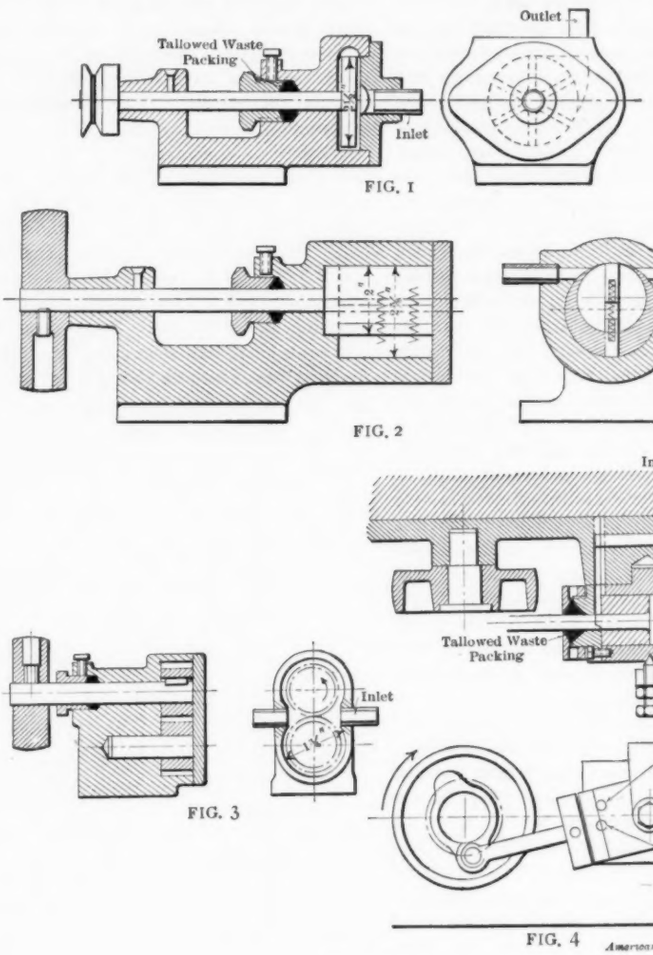
W. OSBORNE.

Oil Pumps.

BY A. L. MILLAR.

In these high-speed days copious lubrication is recognized as a necessity and not a luxury; the drip from the spout of a can or the occasional flick with a wet brush has given way to a constant stream. It is therefore proper to consider the means of circulation—the pump.

The centrifugal pump, Fig. 1, is perhaps the oldest type in use, and its chief advantage is its simplicity; and for many duties, especially when the liquid is gritty, it does good service. In operation it pumps by imparting to the liquid some of the velocity of the blades. It is not very powerful, however, and must be placed



OIL PUMPS.

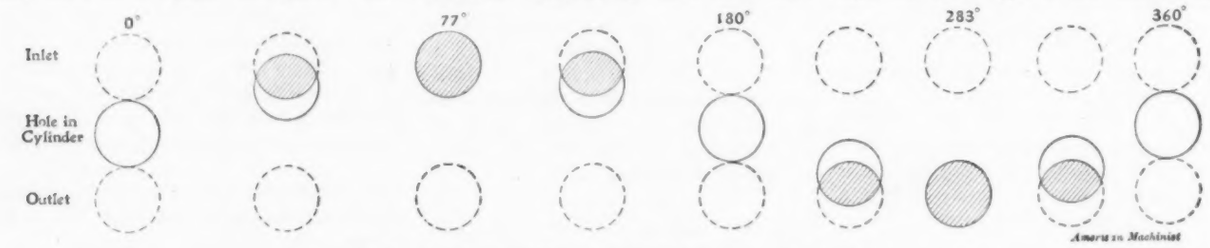


FIG. 5. VALVE OPENINGS AT DIFFERENT CRANK POSITIONS.

below the supply tank, as it cannot draw water up to itself. It must be run very quickly—for ordinary duty about 3,000 revolutions per minute.

It may be as well to state here that the different drawings have not been made to any standard scale, therefore a dimension has been placed on each to give an idea of their comparative sizes.

The slow-speed pump, Fig. 2, has many advantages over the centrifugal; it is, to a certain extent, positive, and runs at a slow speed—70 revolutions per minute. But the springs, which are brass on account of being submerged, do not stand the constant movement well. Though it will draw the supply up to itself from a slight distance when new and well made, it is better for ordinary conditions to place it level or below the supply. Its action is fairly obvious from the drawing. The two blades kept apart by the springs revolve in the eccentric chamber and carry the liquid around with them, the inlet and outlet being dependent upon the direction of rotation.

The geared pump, Fig. 3, which acts, as is well known, by carrying the liquid around in the tooth spaces, is the most powerful of the three kinds; it will draw liquid to itself about 12 inches. A small pump with gears 1¾ inches diameter by 1 inch wide will register 60 to 70 pounds on a gage at about 250 revolutions per minute. A much larger pump, with wheels 3½ inches diameter by 1⅝ inches wide, with twenty-one teeth, registered 300 pounds at 380 revolutions per minute. But to get up to these pressures the pumps must be extremely well made, the wheels fitting the casing very closely both on the sides and periphery. To keep the pump up to anything like these performances the cover requires to be frequently rebedded on the wheels, for if the water can, to any extent, pass between the sides of the wheels and the casing, the efficiency is to a large degree destroyed. It is not advisable to use this pump where the liquid is gritty or where cuttings are liable to get into the supply. Another disadvantage is the fact that the working parts are subjected to much greater wear than in the preceding cases.

The piston pump Fig. 4 is, so far as I am aware, new in design. The principle involved was one used on an engine for a model boat, built many years ago. It is shown attached to the side of the oil tank, which renders it of easy construction. But it is obvious that it could easily be built as a separate unit, in which case the inlet would be brought out to the end in a similar manner to the outlet. The valve gear, if it is pretentious enough to be called such, consists of four holes drilled in the tank side, one blind and one through hole at either end, and a hole in the side of the cylinder at each end. As the cylinder rocks with the movement of the piston, it alternately connects the cylinder with the tank and the outlet. Fig. 5 shows different positions of the holes for varying angles through a complete revolution. The curve Fig. 6 gives the piston velocities and areas of the water passage through half a revolution. It has been calculated out, neglecting the influence of the piston rod, assuming that the holes move across one another with simple harmonic motion. As will be seen from the curve, the area of valve opening at any time is not far from being proportional to the speed of the piston, and, consequently, the amount of water going through the valve, at that time. A piston pump of this design has many advantages. It is simple in construction, has no complicated valves and is easy in action. It pumps on both strokes, which makes the running steady and the jet comparatively uniform. It can, when used for forced lubrication on high-speed engines, be driven by an eccentric placed on the crank or any other convenient shaft. It is positive and has a large output per revolution compared with other styles of pumps.

England.

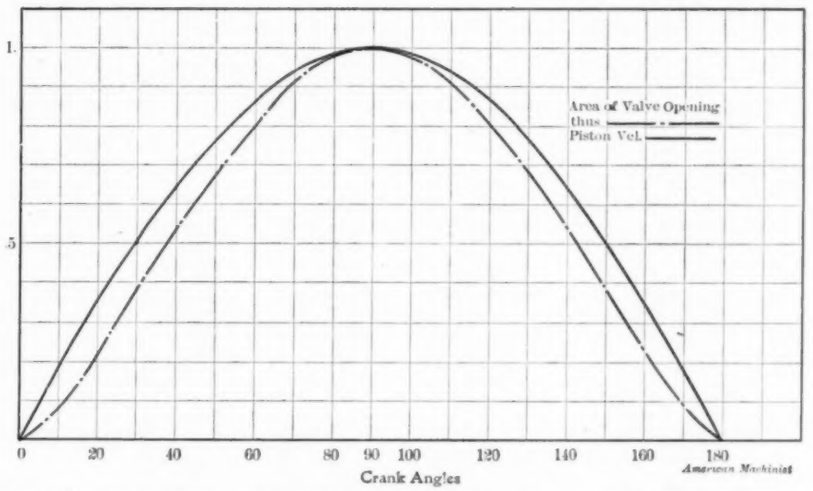


FIG. 6. CURVE SHOWING RELATIVE VALVE OPENING AND PISTON VELOCITY, NEGLECTING EFFECT OF CONNECTING ROD.

Letters to the Editor.

Dimensions on Drawings.

As a contribution for those who are interested in the subject of shop drawings and the different methods of indicating machinists' dimensions thereon, I wish to give in a few words some of the methods used in the two shops in which I have had more or less experience during the last few years.

In the first shop was built high-speed machinery, and some of the parts were quite massive, and there was considerable machine work to be done upon them.

The machines were first built on paper in the drafting room; a complete and quite artistic drawing being made by experienced engineers. These were turned over to the younger draftsmen to be detailed. As rapidly as the detailing progressed, blueprints of these drawings were sent to the pattern shop. On these drawings were put every possible dimension which would be necessary to either patternmaker or machinist. These blueprints were returned from the pattern shop to the drawing room, whence they were sent to the foreman in the machine shop, as the castings were delivered from the foundry.

In this shop were built many different kinds of machines, several machines being under the supervision of one foreman. As many of the castings were very large, it was expected that, on the first machines, there would be an extra amount of labor involved in machine work and general fitting, and numerous changes in patterns would be ordered.

As the erection of the machine progressed, the foreman marked on his blueprints, in lead pencil, all changes and corrections which he considered advisable to be made. When his machine was completed, the full set of prints was returned to the drafting room, where they were filed away, after a new set of drawings had been made. On these new drawings were put only those dimensions which were necessary to the machinist, and the dimensions which involved any changes to be made in the pattern shop.

This method found favor with the foremen and machinists, but had its disadvantages when, occasionally, after some accident or fire in the foundry, it became necessary to make new patterns. In this case the patternmaker was compelled to use two drawings, from which to make his new pattern, looking upon the original drawing for all dimensions which were not shown on the new one.

This system proved to be unsatisfactory at times, for it occasionally happened that some difficulty was met when it became necessary to furnish repairs for machines which were far from home.

Here all dimensions on drawings were given to the nearest 1-16 inch, as it was not often found necessary to be any more

accurate, except in special cases with gearing, where hundredths of an inch were sometimes indicated. Needless to say, their stock of ring, plug and other gages was rather small, and their line of jigs was not so large but that one man could take care of them all.

In my present line of work, much greater accuracy is necessary, and all dimensions are given to absolute sizes; shrink, press, driving and clearance fits being indicated thus: 4″ + .002″, or 6¾″ — .0015″, according to the degree of accuracy required.

Upon each drawing are listed the tools required for finishing the piece and any information necessary or helpful to the shop. No expense is spared in the drafting room in furnishing all material to the shop necessary to enable the men to turn out a class of work which is fully up to the standard, both in efficiency and workmanship.

The result of this is sure to be a satisfied and regular customer, insuring a successful and growing business, of which any industrious and active business man might justly be proud. Roy P. Stevens.

Molding a Molding-Machine Frame.

The casting to be made, shown in three views in Fig. 1, is a main frame for a stripping-plate molding machine, made to take in patterns from 4 to 6 feet long, 16 inches wide and 10 inches deep. The side view is shown partly in section. *A A* are the main bearings for the crankshaft, and *B B B B* on the plan are the four spring boxes in which springs extend upward, their tops butting against the pattern carrier to take care of the weight of the pattern when it is being lowered within the frame.

As only two castings were required from this piece, the best method of obtaining these two castings was considered, both in the pattern and molding, and as the method employed gave good results both in this instance and also in several other similar cases, it may be of some use to others making similar work, or it may bring forth some better or cheaper method from some quarters of the globe where the American Machinist circulates.

Fig. 2 is a side view of the pattern, placed in position for being rammed up. The two ribs extending the full length of the pattern are cored out. A plan of the core is shown in Fig. 3.

A hole is dug and a bed is leveled the required depth from the floor surface. The two cores are placed on the bed and the pattern also is placed on the sand bed, the four vertical slides *S S* resting on the sand bed, passing through suitable openings *T T* in the cores. The slides being fastened to the pattern by the battens *U U*, serve the double purpose of setting the pattern in its vertical position and also acting as guides for setting the two cores. The other vertical props are placed in position directly the setting of the pattern has been accomplished, these being located by the cores on the sand bed and by pins in the pattern frame. The mold is now ready for ramming up in the usual way. The sectional side view, Fig. 5, will explain itself. *R R* at each end of the mold are runners, and *R R* nearer the center also are runners. As the metal is very light in parts, the mold is poured with two ladles, one from each end, and two hand ladles on the inner gates. Fig. 4 is a plan of the mold ready for pouring. *V V* are two small flasks clamped to the cope in order to get a parting over the feet and spring boxes, as shown on the

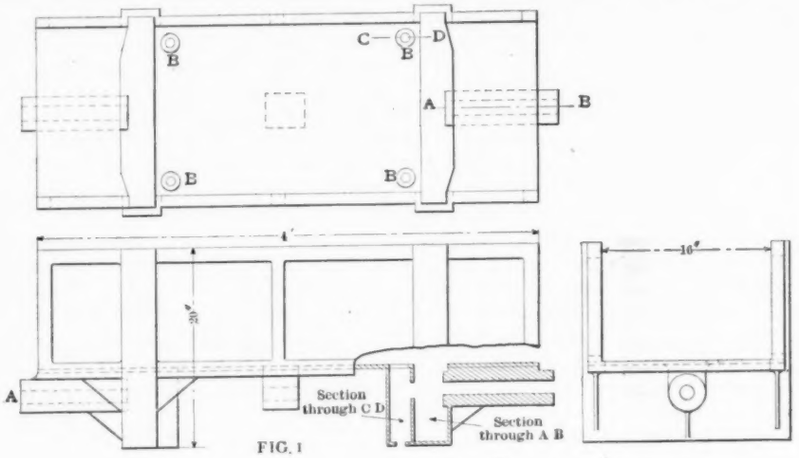


FIG. 1

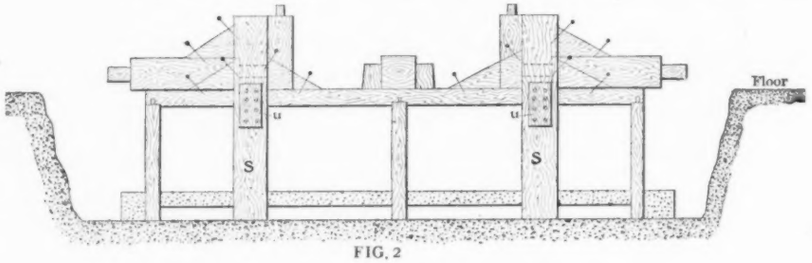


FIG. 2

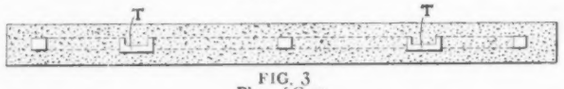


FIG. 3
Plan of Core

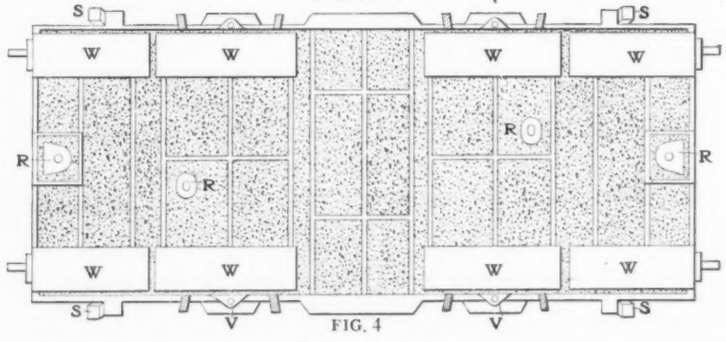


FIG. 4

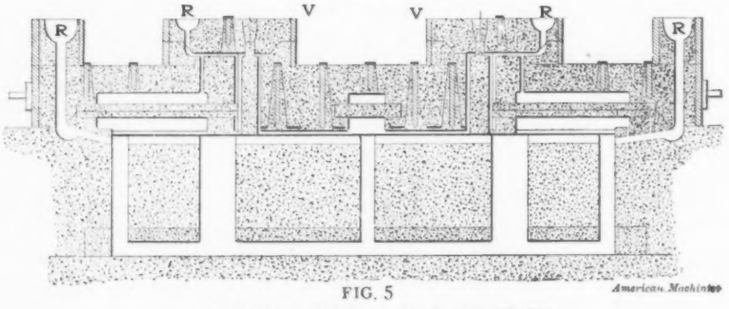


FIG. 5

MOLDING A MOLDING MACHINE FRAME.

section. The weight of a casting is 300 pounds, and the time occupied in molding is quite as short as when using a box of the required number of parts.

Wrexham, N. Wales. G. Buchanan.

Cheer up, Strawboss.

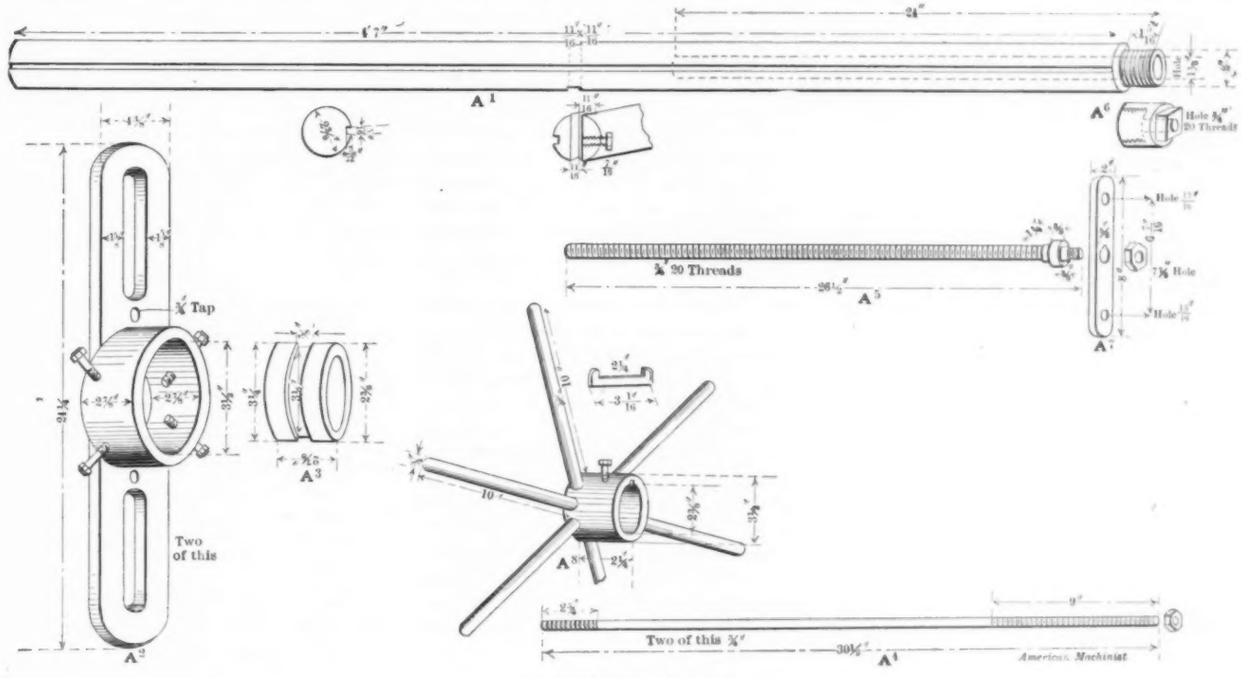
I have read of the woes and troubles of "Strawboss" and the words of his many sympathizers, and have kept quiet on the subject; but when "Another Strawboss" commences (at page 839), I feel that it's time someone held out a helping hand. I was once in a very similar position, but I pulled through all right and came out top of the whole gang in the finish. I was top man in the drawing office, my boss was the manager in general and his son was the works manager. Now, although we sent drawings into the shops to be worked from, I found out that the men were not doing so, and in many cases were working to verbal instructions from the works manager.

This went on for some time, until one day I was told that the manager desired my presence in his office. I walked in and had just time to close the door when I was greeted something like this: "Look here, Mr. Strawboss, this sort of thing will not do at all. There's one of those pulleys on machine 180D that fouls the screw heads, and consequently it won't go right up into its place. Come along and I'll show you what I mean." So we went into the works; in the meantime I had sent a lad for the necessary drawings. We arrived at the machine in question, and it was as he reported: the pulley would not go right up to the shoulder on the shaft. Just then the drawings were put in my hands, and upon examining them and the work, I found they hadn't counterbored the bearing flange to let the screw heads in, although it was shown on the drawing. I pointed this out to the manager; then he had a go at the poor driller, and was told that the manager's son had instructed him not to bother to counterbore them, because it was not necessary. Well, that finished that job. He didn't tackle his son on the subject while I was there; that was a part of the play I missed. Now, although I do not stand in the position of a wiseacre, my advice to the latest Strawboss is to give his boss's "dude of a son" sufficient rope and he'll hang himself. After my little episode, I was left alone and things went on A1, and I hope the same agreeable ending will be in store for all the Strawbosses.

YORKSHIRE.

A Handy Boring Bar.

A bar that can be easily and quickly attached to any gear, pulley, wheel or crank, which will work at any angle and can be operated by hand, is a time- and money-saving tool in any shop or plant having heavy machinery. The following described bar will bore out to 6 inches diameter. It consists of the following parts: One steel bar, *A1*; two binders, *A2*; two adjustment collars, *A3*; two rods, to hold cross-brace for feed screw, *A4*; one feed screw, *A5*; one feed-screw nut, *A6*; one cross-brace, *A7*; one hand-wheel, *A8*.



A HANDY BORING BAR.

Bolt the binders *A2* on each side of the piece to be bored. Put in the bar and true it up by the adjustment collars. Screw in rods *A4*. Put nut *A6* onto the feed screw *A5*, insert the screw into the bar, fastening the nut on the end of the bar. Put brace *A7* onto rods *A4*, using jam nuts to hold it in position. Tighten the end of the feed screw solid to this, then put the hand-wheel on the other end of the bar and it is ready to start boring. By having several feed screws, and nuts with different lead of threads, you can change the feed at will, but for ordinary jobs the one illustrated is all that is required.

E. N. WIEST.

Indicating Machinists' Dimensions on Drawings—Power-Plant Layouts.

I have become very much interested lately in the articles which you have been publishing on the different methods of dimensioning drawings so that the machinist and the patternmaker may readily distinguish the dimensions they are to work to.

Out here on the Pacific Coast the general practice is to make our tracings entirely with black ink, thereby making no distinction whatsoever between the patternmaker's and the machinist's dimensions, and, consequently, there is a great deal of time wasted in our shops by having the machinist running after the foreman to help him read the drawings, and I think that the shops should look into this matter seriously, as it means the saving of a great deal of time.

In connection with this matter, I would like to point out to you an application to power-plant work, which will probably interest a great many draftsmen who have complicated piping arrangements and also proposed extension work to lay out. In laying out the general arrangement of piping in a power plant, we ink in our machinery in blue ink, and then we put in our piping in black ink, so when the tracing is blueprinted the piping shows up very distinctly, while the machinery outlines are faint. Very often we are required to make drawings of proposed ex-

tensions to plants, and, in this case, we show in the present installation in blue ink and the proposed extension in black, which, when the tracing is blueprinted makes a contrast which is very pronounced.

I would like to hear from some of the other drawing rooms on this subject.

F. HENRY SEARIGHT.

San Francisco, Cal.

An Easy Repair Job Ashore.

The "Easy Repair Job at Sea" (page 65, Vol. 28, part 2) reminds me of one I did on shore. I had done quite a lot of work—when the shop was in its infancy—for Max Rosenstein, but things were different now, and I had not forgotten the way old Rosenstein had always cut a little off my bill in the days when I could ill afford it.

Rosenstein's factory was run by a 25 horse-power vertical engine, a good old-fashioned engine with generous wearing surfaces throughout.

Rosenstein's foreman was a German, a nice, decent, quiet fellow, who used to drop into the shop occasionally to borrow tools or beg scraps of wire or brass for repairs—that Rosenstein was too mean to buy. One day he came in as usual, and in course of conversation mentioned that the engine was to be completely overhauled—new crankshaft, new connecting-rod brasses and new main bearings. Skinner had given a price of $200, but Rosenstein had beat him down to $150.

"What has come over Rosenstein to cause him to spend $150 in one lump?" I inquired.

"The engine has been knocking so badly for about two months—and gradually getting worse—that the girls can't work; and besides, the engine don't seem to give the same power it used to. So it's hitting Rosenstein in the pocket; he can't run all the machines, and can't keep his help on the machines that are running. You know about engines; why don't you come 'round and put in a bid? Skinner's prices for work are higher than yours; *I heard Rosenstein tell him so.*"

So I told Schmittz I would be 'round and look the engine over.

At noon, armed with a monkey-wrench, I appeared on the scene. The engine was running and raising a terrible racket, thumping heavily at both ends of the stroke. I shut the steam off and had a look at the bearings without taking them apart. "Plenty of metal there, but very slack!" I exclaimed mentally. Then I turned the crank to top center and opened the steam; she did not start, so I turned the flywheel little by little till the crank was past half stroke, when she started with a jump and a thump on the ends of the stroke. Shutting the steam, I put the crank on the bottom and tested that end, with the same result. Having still a few minutes to spare before work was resumed in the factory, I got a bucket of cold water, took the valve-casing door off, and put it and its nuts in the water to cool off. The valve seat was in fine condition. So I inferred the valve face would be the same. But the valve was away out of correct position on its spindle. After closing up the casing I told Rosenstein that I would take all the knock out of the engine and guarantee the job for fifty dollars.

After a good deal of haggling—during which he told me that Skinner was going to do the job for *forty dollars*—I got the contract and twenty-five dollars on account, the balance to be paid upon completion of the work.

I had agreed that there would be no shut-down, so the job was to be started on Saturday and completed before 7 A. M. Monday.

Two hours on Saturday sufficed to take out liners, tighten up the bearings and set the valve. Rosenstein was sent for to pass on the job. Steam was turned on and all the machines put in operation. The engine ran like a breeze, not a sound out of it. The contrast was so great that Rosenstein forgot himself. Not knowing that I understood German; he turned to the foreman and said, "Die dampfmaschiene rennt wunderschön. Then turning to me he said, "It's a *fair* job, but fifty dollars is too much for two *hours'* work; why, I have people in my employ that don't make fifty dollars in two *months*. I am not going to pay you any more. What you have already received is excessive."

I knew it was useless to argue with him, but formed a plan of action, and with a great show of disappointment said, "All right, you have the cash and I can sue you for it, but as I have no proof that you promised me fifty dollars, I guess I better wash myself, clear out and forget about it."

Smiling complacently to himself, Rosenstein went to his office.

The moment his back was turned I went over to the engine and, by hard work, in fifteen minutes had it in worse adjustment than it was before.

I then went to the office and said, "Mr. Rosenstein, before I go I would like you to look at the engine again. I have done a little more work on it and would like you to see it run, as I think you might change your mind about that other twenty-five dollars."

"Oh, I'll look at it," he said, "but not one more cent do you get out of me."

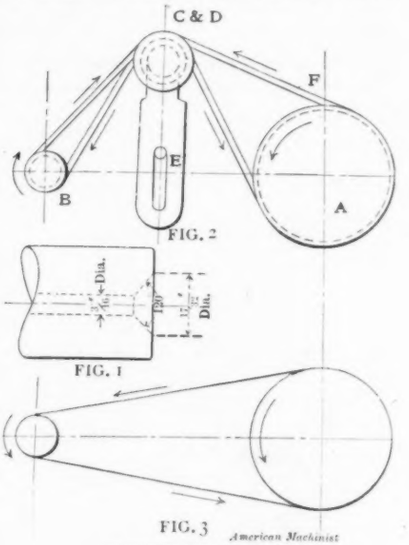
The steam for that engine came up six stories from the boilers in the basement and was not too dry at any time; *now* it was like so much water. The engine made so much noise that it even made me nervous. Rosenstein was in despair—Saturday afternoon and all the machine shops closed—he fairly frothed at the mouth as he stamped up and down, calling me a lot of things that I was, and a lot more that I was not. But the object lesson worked. *I* got the other twenty-five dollars and *he* a quiet engine.

I never would do any more work for him, although he sent for me several times, but I heard indirectly that Rosenstein said I was the best mechanic in the United States and also that I would make a splendid Jew.

DIXIE.

Superfluous Devices.

I remember, when I was a boy working around a silo, seeing a man take a corn chopper apart to "fix" it. When he got it all together again, and the casing around it, there was one little pinion on the floor, and nobody could tell where it belonged. The best part of the forenoon was spent in taking that machine apart again and in hunting for a stud or shaft on which to hang the pinion, but without



SIMPLIFYING A DRIVE.

success. Finally, the machine was started and "tried" with the pinion in my possession. To the surprise of everybody, the old thing moved off nicely without a halt or quiver, and a perfect hail of chopped-up corn stalks flew into the dark hole below. The machine is working today, for all I know to the contrary.

I want to tell of a case where *two wheels* were left out of a machine purposely and with excellent results. The problem was to grind the hardened tool-steel piece, Fig. 1, taking off about 1-64 inch, this to be done on a Brown & Sharpe tool grinder with internal attachment. Fig. 2 is a fair sketch of the driving scheme for this attachment. It consists of grooved driving sheave *A*, grooved driven sheave *B* on the internal grinding spindle center line, "idle" sheaves *C* and *D*, tightening bracket *E* and round leather belt *F*.

Using an emery stick about ¼ inch in diameter, with from 40,000 to 50,000 revolutions per minute for the spindle *B* would be nice; we tried 30,000. After all kinds of trouble with the main driving

belt (from main shaft to counter), we finally had the train in motion. The shaft bearings at *B* began to heat and smoke; pulleys *C* and *D*, running in opposite directions at terrific speed, began to heat and smoke; the belt began to stink and broke. We fussed and fooled with oil, graphite and special belts of our own make for a day or two till we actually got a two- or three-hour run out of it. My spirits were rising beautifully when, with a "swish" and *slip*, the belt broke and all but took away the end of my finger.

I gave it up then, and went out in the air to cool off. I came back with a soft, thin piece of harness leather—the kind of oak-tanned horsehide they make reins of. We threw away pulley *A* and substituted a plain crown 1-inch face pulley; ditto at *B;* no flanges anywhere. *C, D* and *E* and *F* followed *A* and *B*. We stretched on the harness leather as tight as we could and cemented it, changed what right-hand threads we had to left-hand, and started up again. We had no further trouble in getting and keeping a speed of from 25,000 to 35,000 revolutions per minute without serious heating. I have never seen any other drive used with the internal attachment in that shop since, though they no longer buy the harness leather. A piece of ordinary belting, shaved down thin to make it very flexible, is substituted and gives first-rate results.

Moral.—A great many "necessities" exist in the draftsman's brain alone.

ROY JOHN.

High-Speed Steel at Work.

One of the troubles incidental to the introduction of the high-speed steels has been connected with the repairing and strengthening of the machine tools in which it is being used. These machines, being designed for the ordinary carbon steel, and having been some years in use, and so more or less worn, usually broke down in some part or other on account of the increased speeds and feeds made possible. The practice in most cases in introducing the high-speed steel has been to put the tool at work on some job from which a good deal of stock had to be removed, and to increase the speed of the machine till either the tool or the machine gave way, and, as the tool was a long way ahead of the ordinary carbon steel, it has been usually the machine which has set the limit. The consequence of this was that the machine was usually speeded up as much as was thought safe and run at this speed, there being a large increase in the quantity of work turned out; but, as the factor of safety was reduced, the wear of the machine was increased and required more adjustment, and breakages became more frequent. In repairing, care was usually taken to insure that the same part would not give way again. Thus the weak parts of the machine were strengthened, and progress was made toward the evolution of the modern machine tool, capable of using the high-speed steel to its utmost limit.

In this connection, it may be of interest to note one or two cases in which machines have broken down; not when any trial of the steel was taking place, but in actual every-day work after the machine had been running some time at the increased rate. In one instance it was the sleeve of the back gear in a surfacing lathe which gave way. The turner at the time being engaged in surfacing a piece of work requiring a heavy cut, and the belts being tight, the torsional stress was too great for the gray-iron sleeve and it split in two, cracking in a sort of diagonal direction along the sleeve and through the bosses of one of the gear wheels. As the bosses on the gear wheels would not allow boring to a larger size, a cast-steel sleeve was made and fitted in. This stood the stress without any trouble.

Another instance was that of a large combined planing and slotting machine, the planer being engaged in roughing up the face of a large engine cylinder and using two tools in the cutting head. The machine had surfaced a slight distance with this depth of cut when it stuck at the beginning of a cut and the shock stripped and cracked some of the driving-gear wheels, besides bending the shafts and cracking the frame. This was a big smash and practically wrecked the driving gear; but no blame could be attached to the man, as he was simply doing his best to increase the output of work on his machine. In repairing, the frames, not being actually broken, were strengthened as much as practicable by means of wrought-iron plates, the shafts and gear wheels being made slightly heavier and broader.

A machine for cutting off lengths of round bars, etc., was speeded up and at work for some time, when one day, owing to the tool jamming in the cut in a large bar, the top portion of the slide-rest was broken right off, and as there was no satisfactory way of patching it a new and heavier design of slide-rest was substituted. This was a big improvement over the old rest, which had been fairly well worn, and the machine for some time ran very satisfactorily, till the operator broke the spindle clean off at the neck of the journal. This was broken in the same manner as the slide-rest, only the rest being stronger this time, it was the spindle which gave way. As the external diameter of the spindle could not be increased, the hole was made slightly smaller, thus leaving more metal at the neck of the chuck, the chuck also being placed closer to the ground and reducing the overhang.

In the main shafting, where there is a heavy intermittent load, as in the case of a planer drive, some of the coupling keys gave way, the shaft in some cases being so badly chewed up that a fresh end had to be welded on, and there is little doubt that one or two breakages of the line shaft were mainly due to the increased load, as when, for instance, you have a line of shafting 50 or 60 feet long driving long rows of machines and nearly every machine having a larger driving pulley. In this connection, it may be noted that it is often a wooden pulley which displaces a heavy gray-iron pulley, transmitting more power, and that without any sign of fatigue, even when gripping a very small shaft, the old pulleys, if they are in halves, being taken off, and if solid and no room for them in the shaft, broken off.

Another instance was that of a slotting machine of a fairly large size, the main driving shaft being driven by a large gear wheel, this being driven by a small pinion on the cone shaft, this shaft having as usual a large wheel which acts as a flywheel to steady the pull on the belt, and runs as a hand-wheel to turn the machine when setting the work. This large spur wheel was one day split exactly in halves when the machine was taking a fairly heavy cut. The new wheel was made slightly heavier all over. The feed gear in some slotting machines being moved by a face cam, the higher speeds found out all the worn places and caused the feed rods and levers to jar, resulting sometimes in a very uneven feed. Taking up the slack in the joints and putting in new cams usually cured this.

In drilling and boring machines, where the spindle usually slides in a sleeve, being driven by one or two keys sunk in this sleeve, the wear on these keys is usually very great, the edge of the keyway in the spindle sometimes being squeezed over enough to bind the spindle in the sleeve. Putting in a longer key usually helps this, and if there is only one keyway in the sleeve another keyway can be cut on the opposite side, thus reducing the pressure on any one key by half. When new keys are being fitted in a machine in which heavy work is done, it is best to fit them in the style adopted by some machine-tool makers of making the lip of the keyway in the spindle broader than at the bottom; for instance, a keyway, say, ½ inch deep, would be ½ inch broad at the bottom and ⅝ inch or ¾ inch broad at the top. This arrangement is best when there is a keyway on each side of the sleeve, and has the advantage that it is nearly impossible to crowd over the edge of the keyway as the thrust is applied axially in the spindle.

The stripping of the small gears for driving the feed gear of the lathe occurred now and again, principally owing to the lathe driver slipping on the work when a heavy cut was being taken, and the lathe not being stopped soon enough, something had to go. More attention has to be paid to the back center for taking up the thrust on the lathe spindle, the heavier cuts taken at a high speed carrying a much greater thrust and demanding more at-

tention to lubrication, or if this does not prevent heating up, increasing the area of the thrust surface. W. BURNS.

Device for Forming Hard Sheet-Rubber Boxes.

Fig. 1 represents a hard rubber brush box, ½x1½ inches inside and 1 inch deep, with walls ⅛ inch thick. Inside this fits freely a rectangular carbon brush, which is held against the commutator by suitable springs. This box forms an insulating lining for a rectangular cored hole in the brush-holder casting.

The problem presented itself of making these in quantities from hard sheet rubber. This material, as is well known, is very brittle when cold. However, when heated by placing in hot water, it becomes quite pliable. After some experimenting, the device shown in Fig. 2 was made, and used with good results.

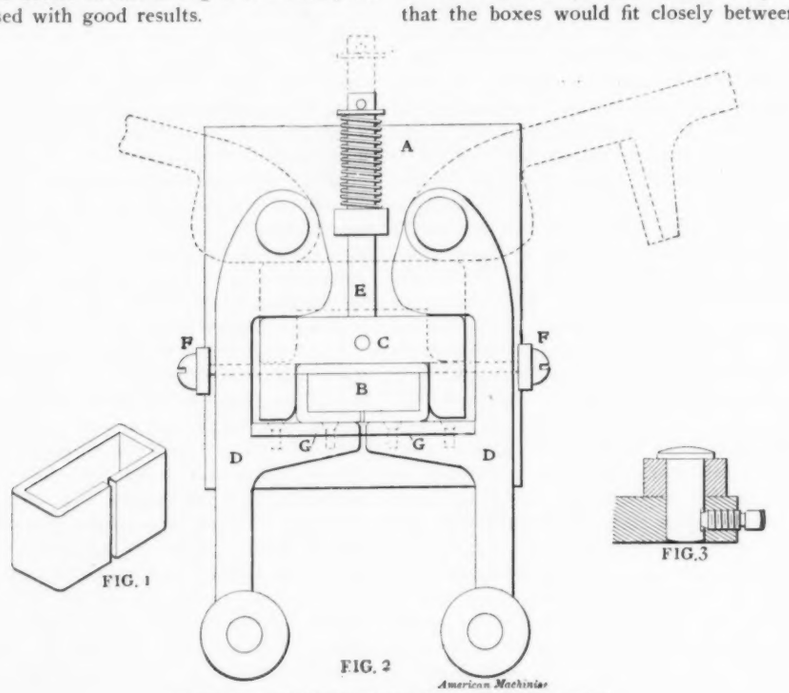


FIG. 1

FIG. 2

FIG. 3

DEVICE FOR FORMING HARD SHEET-RUBBER BOXES.

To a flat steel plate *A* is attached a rectangular block *B* of the same length and width as the inside of the brush box, and projecting above the plate to a height a trifle greater than that of the box. *C* is a U-shaped sliding block operated by the cams on the levers *D D*, being held against them by the coil spring shown. This block is guided in its movement by the stem *E* and a stud, not seen, which is on the under side, and works in a slot in the plate *A*. The sketch shows the levers in their final position after forming the box.

A small tank was provided with a means of keeping the water at constant temperature. The temperature found to be right ranged from 160 to 180 degrees Fahr., and varied some with the different sheets of rubber used. The rubber was cut in strips the right length and width and placed in this tank.

Referring again to Fig. 2, the initial positions of the parts are indicated by the dotted lines. A piece is taken out of the water and quickly placed between the stops *F F*, and the handles are grasped and brought around to the final position. The way in which the device bends the rubber around the piece *B* is, I think, clear. First the cams bring up the sliding piece *C*, bending the rubber into a U-shape, when the plates *G G* come into action and bend over the ends. After allowing a short time for the rubber to cool, the handles are swung back to the initial position and the formed box lifted off.

It was found that, after lying a few hours, the boxes would open out some, and in that shape take a permanent set. To prevent this, they were placed as fast as made between parallel strips of wood nailed to a board, such a distance apart that the boxes would fit closely between them. One board would hold about 100. They were left in their places on these boards until the time for inserting permanently in the brass brush-holder castings.

The fixture was used fastened down to a bench. The time required for the rubber to cool was slight. A dash of cold water in the fixture now and then was found to help.

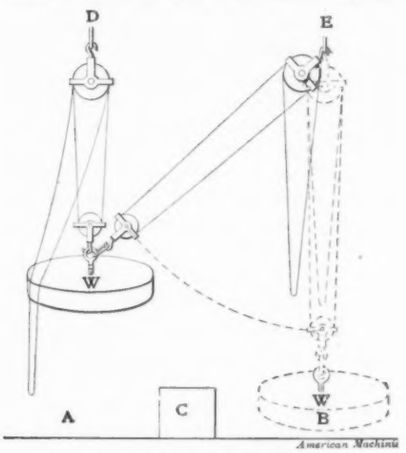
In our first trials with this the corners of the box would break, and while this difficulty was practically overcome, still, at best a few would be lost on that account. It was found that the opening in slide *C* must be of such a width that it would bend the rubber around squarely, but not draw on it in doing so, and the plates *G G* must press hardest at the points.

A certain feature in the construction of this device brings to my mind a point in jig design I take occasion to bring out. To provide a stud for such parts as the levers here shown to swing on, a shoulder screw is very frequently used. If "things which are usually wrong" are ever found in jig construction, this is one of them. A plain stud like Fig. 3, made a driving fit in the hole, is far better, and is cheaper to make. If the driving fit is not desirable, a set-screw against it, as shown, makes a substantial job.

H. B. MCCABE.

Chain Hoists as a Traveling Crane.

The weight *W* was to be moved from *A* to *B* over the obstruction *C*. In this case *W* was a cylinder cover of a marine engine, and was lifted off its studs and moved to *B*, so as to be out of the way while the cylinder and piston were being examined. *W* had always been lifted by a 3-ton block far enough for skids to go under it. Then it was dragged along the skids as far as *B* by an ordinary block and fall. This took six men. By the method shown, *W* was lifted straight up by one man with a 3-ton hoist *D*. The hoist *E* was then hooked into a shackle on the eyebolt—by the same man—and the bottom block pulled up taut. Hoist *D* was then lowered away, and the weight swung to *B*. This operation reversed, put it back at A when the examination was over. I do not claim any novelty for this way of handling the job, but the chief engineer told me that the old way had been used for about fifteen years.



A LIFT WITH CHAIN HOISTS.

DIXIE.

Removing Finished Work From the Turret Lathe.

At page 529 Paul Wesley shows his method of removing whirls from the arbor in the turret lathe spindle. I do not like the idea of using a hammer where it is not necessary, as the person who is using it is likely to do some damage with it. A mandrel I have used on similar work is threaded back of the taper portion and has a nut to force the work

off. This answers the purpose and there is no chance of bending the mandrel or getting it out of truth in any way. The nut has six holes for a pin spanner, so that it can be got at in whatever position the lathe spindle stops.

C. PETITJEAN.

London, England.

Storing Pulleys—A Follower Rest—Comparative Cost Diagrams.

Here are a few more ideas and methods gleaned from the practice of a textile engineering works.

A common method of storing pulleys

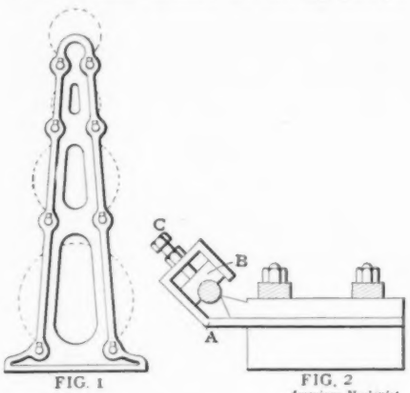


FIG. 1 FIG. 2

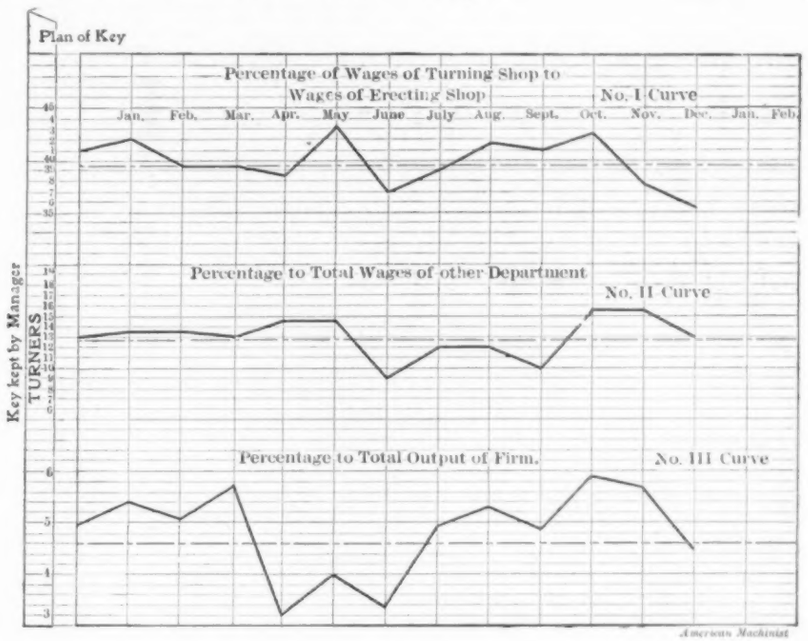
American Machinist

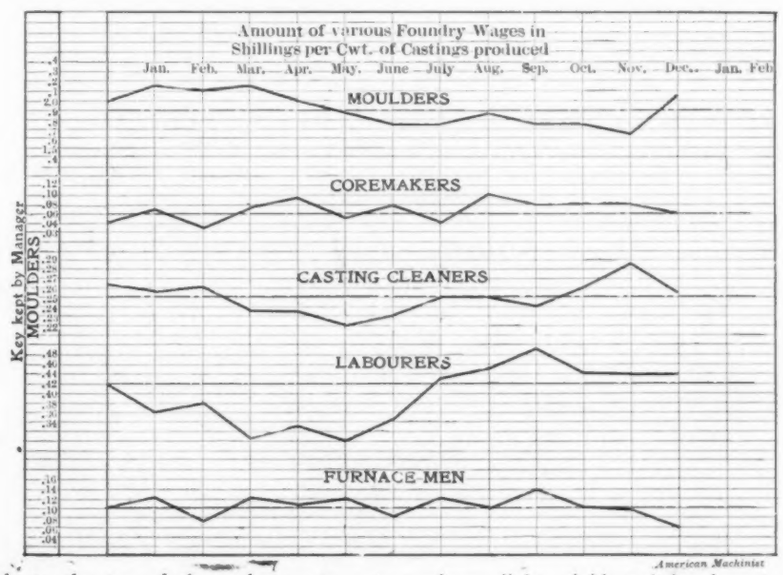
A PULLEY STAND AND A FOLLOWER REST.

and wheels is to thread them on vertical rods, and it is about the worst plan that could possibly be chosen. If the bottom wheel or pulley is the one wanted (and it generally happens to be), one is under the painful necessity of lifting every article to the top of the rod once to get it off and again to put it back, after the manner of lunatics whose task it is to keep shifting a dirt pile from one place to another until they show signs of recovery by awakening to a sense of the futility of the performance.

A much better plan is indicated in Fig. 1. The sketch shows a gray-iron standard about 5 feet high and ½-inch section with four pairs of cored holes large enough to take black-iron bars without drilling and each hole with a taper key-slot cast in. The two top bars may be ⅞ inch diameter, the next 1 inch, the next 1⅛ inches and the bottom pair 1¼ inches The stands are placed in position from 5 to 8 feet apart, depending on the weight of the goods to be stored, the bars cut to length are passed through and then ¼-inch square iron is driven into each keyway and cut off flush. The result is a cheap, light, rigid and handy set of shelves which will hold all kinds of wheels and pulleys conveniently and securely, and from which any article may be taken at will without disturbing any other. Anyone constructing such a set of storage shelves will be astonished at the variety of things that can be stored on them better than in any other way. The sketch shows a series of different-sized pulleys in position.

Some of our lathes never had a follower rest, others used to have one before the last "moving" and others are possessed (the word is deliberately chosen) of one of the kind that takes two men to lift and is knocking lumps off the face-plate several inches ahead of the tool. In all these cases and many others where light work is to be done I heartily recommend the makeshift shown in Fig. 2.


Plan of Key
Percentage of Wages of Turning Shop to Wages of Erecting Shop
No. I Curve
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb.
Percentage to Total Wages of other Department
No. II Curve
Percentage to Total Output of Firm.
No. III Curve
Key kept by Manager
TURNERS
American Machinist


Amount of various Foundry Wages in Shillings per Cwt. of Castings produced
Jan. Feb. Mar. Apr. May. June July Aug. Sep. Oct. Nov. Dec. Jan. Feb
MOULDERS
COREMAKERS
CASTING CLEANERS
LABOURERS
FURNACE MEN
Key kept by Manager
MOULDERS
American Machinist

The packing piece *A* is carried forward and bent over to hold tightly a hardwood shoe *B*; a set-screw *C* takes up the wear of the shoe. The holder may be strengthened at its weak corners if need be, but I have seen ⅞-inch bars 24 inches long turned up very nicely with the help of such a stay bent out of 1x½-inch iron.

At page 479, of volume 27, Mr. Bickford advocated the publication in the shops of plotted curves showing the progressive cost of various products. The coming of the suggestion just when it did was a singular coincidence for us, for only a few weeks previously a very similar scheme had been successfully established at our works, except that in our case the diagrams did not refer to articles, but to departments and were for the instruction of the foremen instead of the men. The system has proved itself so valuable that it will be worth while to outline it here.

In our works, as in most others, a certain class of product is being handled month by month without very much variation, and therefore the work done in each department bears a fairly constant proportion to that done in any other, or in all, and also bears a more or less constant proportion to the value of the firm's output.

The aim of our diagrams—Fig. 3—therefore is to show to each foreman month by month the relative proportions which the wage-costs of each department bear to: (1) the wages of certain other departments; (2) the wages of all other departments; (3) the total output of the firm.

The various departments comprise the erecting, turning, milling, drilling, grinding, packing, painters' and joiners' shops, also the smithy, foundry and sundries.

The erecting shop may first of all be placed in a class alone, for here all the material supplied by all the other shops is assembled, and from here all the assembled material is sent to be packed and delivered. The wages of the erecting shop therefore need only be compared with the wages of all other departments and the value of the firm's output.

The other departments enumerated come into another class. They each supply their share of material to the erecting shops, but sometimes through—one or more—other shops. They also contribute each one its share toward the output of the firm. The wages of each of these departments should therefore be compared with those of the erecting shops, those of all other shops and with the total output.

For each foreman a sheet of square paper, about 12x9 inches, is prepared and gummed on stout cardboard. Such a sheet, made out for the turning-shop foreman, is shown in Fig. 3. There are no actual figures on the sheet. They are kept by the manager on a separate slip, folded down its length, so as to grip the card when the month's results are being added (see left of Fig. 3). The only thing which needs any explanation is the dotted line to each curve. This is an average obtained over many years, to act as a guide and standard. The economical foreman keeps below the line; the extravagant one, above it.

Of course the results shown by the curves must not be taken too literally, or without judgment. For instance, a bad month in the fitting shop will make every other foreman's Curve I look very smart, while a few days' delay in getting away a large order at the end of a month, which throws the delivery into the next month, will make Curve III go first into the skies and next into the depths. Yet by taking the net results of the three curves together, a really good idea of the position of each department and the ability of its foreman can be obtained.

There are a few minor evils attendant on the system, which will always require watching and counteracting. A foreman must not throw work on to another department to lessen his wage bill without showing good cause; neither must he send up poor work to give trouble elsewhere; also the tendency to keep the staff so low that other departments are hampered by want of material, must be nipped in the bud.

The manager will find it a useful plan to keep his own card also showing him the percentage of total wages to total output and the percentage of sundries wages (engineers, millwrights, storekeepers, etc.) to output.

The foundry, besides having its card of percentages like the other shops, has a card showing the wage relations of its various branches to the weight of castings produced. Such a card is shown in Fig. 4, and needs no further explanation.

The whole of the above percentages may be obtained from the figures by slide-rule quite near enough for all practical purposes, and the month's results marked on the cards in less than an hour; so that I think your correspondent's definition of "system" as against "red tape" will apply —"It saves more than it costs."

Bury, England. JOHN HILTON.

Economy in Fresh Air.

It was winter, and the superintendent of a large-sized manufacturing works in Pennsylvania was always whining about the inefficiency of his men. "They were the dopiest, sleepiest, sickliest crowd he had ever seen," and it certainly appeared as if he had just claim to use these words, because the men actually were all listless and sleepy. They would start in the morning with a good will, but after a short time would slow down and work as if it hurt them, and the only excuse they could give was: "That tired feeling."

It certainly was not the cold, for although it was bitter cold outside, and any man who went out or came in had to close the door pretty quick, yet the shop was kept almost too warm by means of a long coil of steam pipe which ran four times round the room about ten inches from the ceiling and was heated with live steam. The men used to say that the heat coming down from the coils gave them a headache, but after the superintendent said a few words about "tenderfeet" no more complaints were heard. Men were fired and new ones were tried, but it all came to the same thing; the new man might start with a promising brilliancy, but very soon he would be dragging along with the rest.

One day the doctor told the superintendent that he had consumption and sent him to the mountains for a cure, and then the boss got a young man to act as superintendent. The first day the new superintendent came in the shop he looked at the heating arrangements in an astonished sort of way, and asked old Bill how long that thing had been running. "'Bout eight years," Bill grunted. Nothing more was said, but in three days a large ventilating fan arrived, and John, the storekeeper, rushed in with the news that it was to be used to force fresh air into the shop. The boys were up to a man. "If that 'fresh' kid was going to blow a blast of ice-cold air across their backs just to please some fad idea of his, well, there would be trouble, that's all," and much talk followed about "reaching the limit" and worse things.

But there was no trouble, and there was no kick coming. A large radiator was made out of 1-inch pipe, which was enclosed in a sheet-iron casing and placed on the roof. One end of this casing was left open and the other was tapered down to a circle where the fan was placed, and then it curved downward to a 14-inch diameter cross-pipe in the shop, which had a lot of distributing branches along it. The exhaust steam from the engine was led into a by-pass valve, so that it could be turned into a new radiator or to the exhaust pipe, or regulated as desired between the two. The storekeeper had charge of this regulation and kept the temperature of the shop about 65 degrees Fahr. (It is worked by an automatic arrangement now.)

Very soon many improvements were noticed. The men were losing "that tired feeling" and had more energy, some whistling or singing, and they all seemed to work with a good will. The firemen noticed that less coal was needed to keep up the steam pressure, and the cost-keeper was pleasantly surprised to see that the cost of production had decreased to a considerable extent.

Some time afterward old Bill was expressing his opinion, and among other things he said: "Well, if any man had told me that that fresh-air fad of the super's would have boosted the shop up like this I would have told that man he was a darn fool, and yet when you figger it out it seems reasonable enough. I wouldn't go back to that old hair-scorcher again for $40 a week," and the other boys nodded their approval.

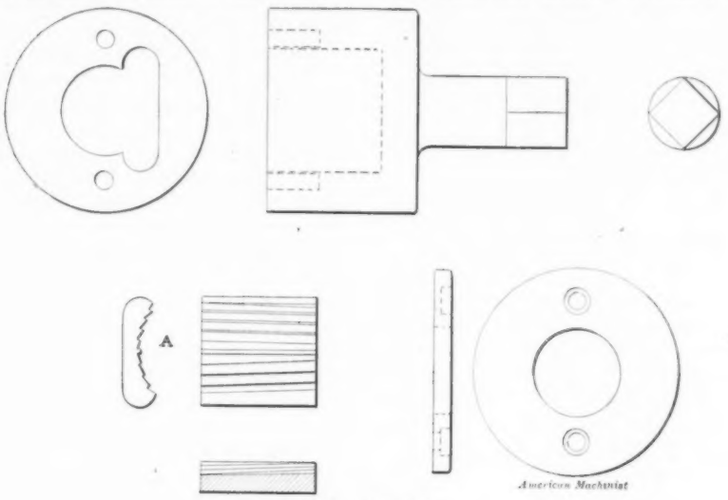
GEO. P. PEARCE.

Dangers of the Wood Planer.

The "device for use in planing short and thin pieces for patterns," illustrated at page 94, Vol. 28, sent in by W. M. Fox, is, I think, an admirable arrangement for the purpose, and if generally used would be the means of preventing many accidents. Only a few days ago one of our apprentice boys in the pattern shop, son of the foreman, lost a hand using a surface planer. I have no doubt that had he used this arrangement the accident would have been avoided. I would suggest as a possible improvement to drive two sharply-pointed wire nails through the front end, and at intervals, according to the length of the work, allowing the sharp points to project about an eighth of an inch on the bottom to insure against any possible shifting of the piece on the front. J. J. NEWBAKER.

Staybolt Chuck.

The drawing illustrates a staybolt chuck, designed and built in the toolroom of the Atchison, Topeka & Santa Fé Railway at San Bernardino, Cal. This chuck is used for putting in and removing new staybolts in a locomotive boiler. By its use the time and expense of squaring the heads of staybolts is eliminated.



STAYBOLT CHUCK.

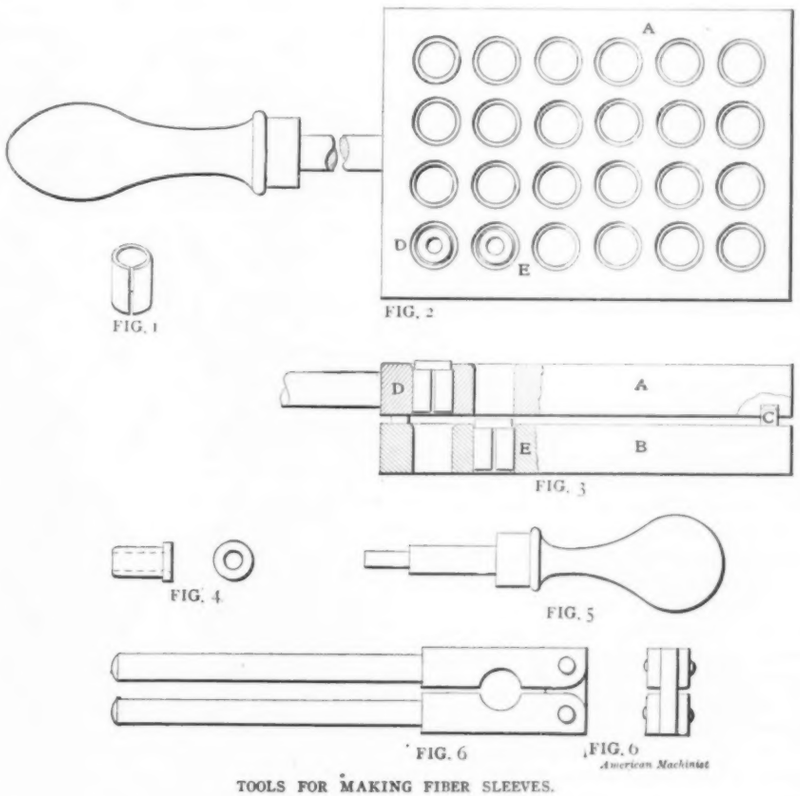
The chuck being inserted in an air motor is placed over the end of the staybolt, the piece *A* clutching it automatically. Machine steel is used throughout in the manufacture of this tool, with the exception of the clutch, which is of tool steel and hardened. G. E. B.

Making Fiber Sleeves.

Small split sleeves, like Fig. 1, made of hard fiber, were used as insulators in a certain electrical device. They were 7-16 inch inside by 9-16 inch outside diameter and ⅝ inch long. They were required in large quantities and were at first machined from the solid fiber rod. This was found to be a very slow process, and the sleeves made were very weak. A much stronger and better sleeve was made much more rapidly from 1-16 inch sheet hard fiber by use of the appliances here shown.

The outfit consisted of a steel plate *A*, Figs. 2 and 3, ¾ inch thick, perforated with twenty-four holes reamed 9-16 inch, the same diameter as the outsides of the sleeves to be made, and provided with a handle as shown; the similar plate *B*, without a handle; twenty-four steel cores like Fig. 4, each having a diameter of 7-16 inch, the same as the inside of the sleeve to be made, one end having a flange slightly less than 9-16 inch in diameter and a ¼-inch hole drilled clear through; a handle, Fig. 5, provided with a shouldered stem fitting the holes in the cores, and a hand former, Fig. 6, made on the nut-cracker idea, as shown. The plate *B*, Fig. 3, was provided with a dowel-pin *C* in each corner, fitting holes in *A* and bottoming in them, so that when placed together the perforations in each plate would register with those in the other, and the plates would be held about ⅛ inch apart.

The sheet fiber was cut on a tinner's squaring shears into pieces the proper length and width. These were placed in warm water and allowed to remain until quite soft. The plate *A* was placed over a gas stove and made hot enough to boil off a drop of water. A piece of fiber was taken from the water and bent around one of the steel cores with the fingers of one hand, while with the other hand the clamp, Fig. 6, was made to complete the operation by bending the fiber all the way around the core and retaining it. Then, while still holding the handles together, this clamp was placed on top of the hot-plate *A* with the core directly over one of the holes, when, by means of the handle, Fig. 5, it was pushed down out of the clamp and into the plate, carrying with it the fiber sleeve. After filling all the holes in this manner, the hot plate *A* was placed on the cold plate *B*, as in Fig 3, and by means of the same handle all the cores with their fiber sleeves were pushed down into the holes of plate *B*. The successive positions may be seen at *D* and *E*. This cold plate having absorbed the heat from the fiber sleeves, they could all be pushed out and another lot of twenty-four started. The shoulders on the cores assured square ends on the sleeves, and no further operations on them were necessary. A boy would easily make 125 per hour. H. B. McCabe.



TOOLS FOR MAKING FIBER SLEEVES.

Cageless Roller Bearings.

At page 54, Part II, "Theodore" asks if anyone has had favorable experience with cageless roller bearings. I have had both favorable and unfavorable experience with them, though I never tried to skate on them. Before roller bearings were much heard of in this part of the country I got an idea that if a ball bearing was good for a bicycle that I could use roller bearings to good advantage, so I put a set on a light traveling crane—just threw in a fistful as Theodore suggests. And it started off just about as well and no better than his did. Then we went to work

and did a good job, just as we ought to have done at first. We turned the journals the same size all the way. We bored the wheels the same size all the way. We used drill rod for rollers. We made the rollers and the journal together to fill the bore of the wheel snugly, and so proportioned the journal and the rollers that there was just about half enough room left for another roller. Then they ran O. K. We afterward used the same thing on a 10-ton traveling crane, both for bridge and trolley, and for a jib crane which swung around a stationary post, with entire success. All these jobs lasted at least ten years. Another similar case was a thrust bearing which was fitted up, while I was away, with cylindrical rolls. It took the thrust of the worm on a 2-ton elevator. It ran, but in a very short time we found that it was badly chewed up and the rolls were barrel-shaped. We substituted conical rolls with washers to fit and had no serious trouble with it, though it would last only three or four years at a time.

E. H. FISH.

Worcester Polytechnic Institute.

A Present Help in Time of Trouble.

Does it pay to file away mechanical papers? Some men will say, "I have no place to keep them; they accumulate so fast." While in a small town in Michigan I called at a machine shop on business. The motive power was a 5 horse-power gasolene engine. The proprietor told me the shop was shut down on account of the engine being out of order. "I know," said he, "what is the trouble, but I don't know just how to go at it to repair it." Just then one of these country machinists dropped in. This fellow did not have the practical experience that one gets in the city, but he could do a good job and give our city machinists "cards and spades" when it came to reading up on mechanics. He saw the old man was stuck and offered to help him. After explaining the trouble to the young machinist he was stuck, too, for a moment, but the thought came to him that he had seen an article on that subject in the AMERICAN MACHINIST. He said nothing about the article, but he went out quietly to his home, got his AMERICAN MACHINIST, posted himself on the part of the engine that gave the old man trouble, came back to the shop and in a quiet way soon put the engine in working order.

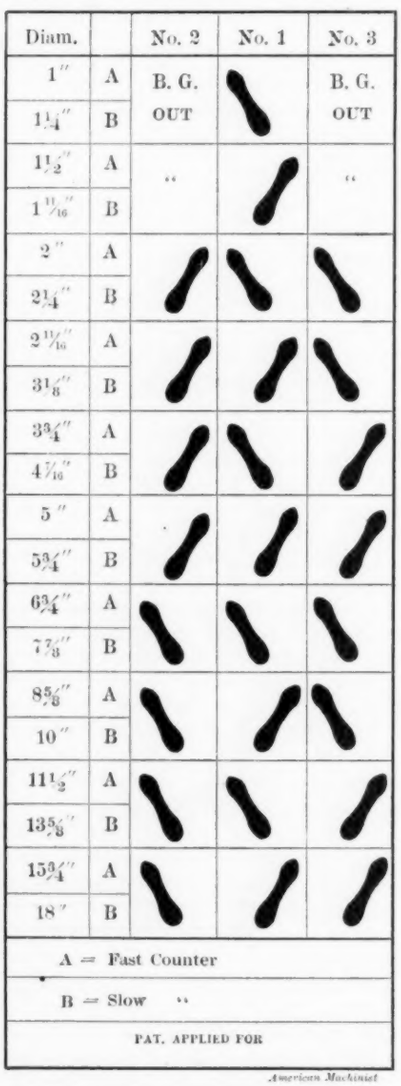
I visited this same town on business about two months after, and I learned from the old man that this young machinist was in charge of his shop. I talked with the machinist about fixing the engine and about his position, and he said he got it through that little article in the AMERICAN MACHINIST, and he added: "The old man don't know to-day that I got that information out of a mechanical paper."

My business brings me into all kinds of shops in the iron business. About a week ago I called at a repair shop located on one of the main automobile roads. In this shop the proprietor said he could do almost any kind of repair work without much trouble. "Automobile work, though, is a sticker; but with the assistance of mechanical papers I manage to pull through some way." On his desk lay an AMERICAN MACHINIST, and I never saw such a display of oily finger marks. I spoke about the finger marks, and he said: "I take the paper to read and learn, and not to put it away as soon as I get it." I noticed that he had the back numbers marked with tags. I read some of these and saw that they all referred to articles on gasolene engines or automobiles.

SALESMAN.

Geared-Head-Lathe Features.

The other day I wandered into the shops of the Draper Machine Tool Company, and in looking around my eye was caught by a peculiar-looking plate on the headstock of one of their geared-head lathes. I secured a blueprint of this plate, which I inclose. At first sight I thought the three-legged man had escaped from the circus, which was in town the day before, and gone on a drunk, and that this was a reproduction of his tracks. Mr. Carrel set me right on it, however, and the scheme seems so neat that others ought to know about it, for its use is by no means limited to lathes.



GEARED-HEAD-LATHE PLATE.

On the front of their geared-head lathes are three levers which correspond to the three columns of figures in the blueprint. The countershaft also has two forward speeds—*A*, fast, and *B*, slow. Suppose the workman has a piece 6 inches in diameter to turn, he looks down the diameter column till he finds 5¾ inches, which is the nearest given to 6 inches; he sees that he must put the counter on the slow speed, and then must push all the levers over to the right. This will give him whatever speed on the cut the countershaft is speeded for, in the case which I saw, 75 feet per minute. The workman can set for any size piece instantly by looking at this plate and he doesn't even have to read much English. More than this, as the foreman comes around he has only to glance at the work being done, estimate the size, look at this plate and the position of the levers to determine at once whether the workman is pushing things or not. There is no chance for argument either, and the machine is sufficiently powered so that there isn't much chance for the workman to say: "Well, I had it on the next step and the belt slipped."

Another thing which was interesting was the number of speeds obtainable and their nearness to each other. In most, if not all, cone-driven lathes there is a variation of around 50 per cent.; that is if you can get a certain speed on a piece 12 inches in diameter, you can get that same speed on pieces 8 inches and 18 inches in diameter, but nothing nearer. On this lathe you can't get more than about 1⅛ inches away from a correct speed. These speeds are in as near geometrical progression as even Art Isan called for a few weeks ago. Of course with gear drive fractional teeth are hardly allowable, so a certain amount of approximation is necessary, but in this case the ratios between successive speeds do not vary more than from 1.1 to 1.25 to 1, which is pretty close.

E. H. FISH.

Worcester, Mass.

The blacksmith shop was short of billets. Sets of guides were required for wreck repairs of two engines which were greatly needed on the road. The foreman of the blacksmith shop used old boiler steel. It was piled, heated in an oil furnace, welded and hammered into guides. This mild steel is now giving excellent service in those guides.—*American Engineering and Railroad Journal.*

An Experimental Determination of the Coefficient of Discharge of Air.

BY SANFORD A. MOSS.

The General Electric Company had occasion to measure quantities of air at moderate pressures by discharge through orifices. In order to secure reasonable accuracy in this work, I have determined the co-efficient of discharge for one of the orifices under the actual conditions of use. The methods and results are given herewith.

The orifice was a short tube, 1 inch in diameter, with rounded approach. The initial pressure was varied between 4 and 8 pounds per square inch above atmosphere, and the discharge took place directly into the atmosphere. All precautions were taken to secure reasonable accuracy, but extreme refinement was not attempted.

The result obtained was that the actual discharge of air through the orifice is found by multiplying the theoretical discharge, as computed mathematically, by the co-efficient of discharge, .942. This value is in good agreement with published values for other conditions. No experiments have ever been published covering the ground of the present ones, so far as I am aware.

The method used was briefly as follows: A large closed tank, about 5 feet diameter and 12 feet long, was filled with compressed air at about 110 pounds pressure, and then closed and connected so as to discharge through the orifice. A throttle valve between tank and orifice was manipulated by an attendant so as to maintain an absolutely constant low pressure at the orifice, while the tank pressure decreased from 110 pounds to about 10 pounds per square inch. During the discharge, which lasted about five minutes, observations of instantaneous values of tank pressure and temperature were taken every fifteen seconds. From these observations and the known volume of the tank, the quantity of free air in the tank at the beginning and end of the run was computed. Dividing the difference by the length of the run gave the rate of discharge through the orifice. Full details of the exact procedure throughout are given later.

THEORY OF DISCHARGE THROUGH AN ORIFICE.

An orifice, or nozzle, is a short passage through which a fluid is discharged from a region of high pressure into another region where the pressure is lower. Thus, an orifice may be simply a hole drilled in the side of a tank, or it may be a tube of appreciable length, with a well-rounded approach, as shown by Fig. 1 for the present case.

The science of thermodynamics furnishes theoretical formulas, given later, for the discharge from orifices, which are the same, regardless of orifice shape. However, eddies and friction losses occur during the discharge which are not taken account of by theory, and which cut down the quantity discharged. The amount of these losses depends upon the shape of the orifice. Therefore, in order to calculate the actual discharge, there must be introduced into the formula an empirical co-efficient of discharge, which can be determined only by experiment. The friction losses are most likely to be uniform for an orifice with a rounded approach, so that such a one is preferable to one with a sharp entrance, for measurement purposes. The exact shape of the rounding probably has little influence. In some experimental work carried on by the Massachusetts Institute of Technology, an orifice was used consisting of a short tube whose length was one and one-half times the diameter, preceded by a round corner with radius equal to the diameter, and this shape was used in the present work.

It is always supposed that the fluid enters the orifice from a region where the velocity is so small as to be negligible, as compared with the discharge velocity. If this is not the case, a correction must be made. The pressure and temperature of the fluid in this region are called the initial pressure and temperature, and they must be known in order to compute the discharge. As will be shown later, for the pressures here considered, air should enter an orifice from a pipe at least about three times the orifice diameter in order that the error introduced by neglecting the entrance velocity shall be less than one-half of one per cent.

In discharging any gas through an orifice, there are two entirely distinct cases, each having its own formula. There is a certain "critical pressure," which is about one-half of the absolute initial pressure. The character of the discharge and the formulas to be used, depend upon whether the pressure of the region into which the discharge takes place is above or below this critical pressure. *We shall deal only with the case where the region into which the discharge takes place is above the critical pressure.* That is to say, the absolute initial pressure is less than twice the absolute pressure of the discharge region. For this case, the ordinary methods of thermodynamics can be directly applied, as shown below. For the other case, some complications occur which we need not here discuss. It may be remarked that Fleigner has developed some empirical formulas for the case we discuss, which are sometimes used. However, since these formulas have no rational basis whatever, and since it is perfectly easy to develop rational formulas, as shown below, there is no good reason for the use of Fleigner's formulas.

DEDUCTION OF FORMULA FOR DISCHARGE.

We will very briefly deduce the formula for discharge of air from an orifice. Let subscript$_1$ denote initial condition and subscript$_0$ denote discharge condition. Let V denote velocity in feet per second, p pressure in pounds per square inch, v specific volume in cubic feet per pound, T absolute temperature Fahrenheit, J the mechanical equivalent of heat, c_p the specific heat of air at constant pressure, c_v the specific heat at constant volume, and K their ratio. Let d_1 denote the diameter of the pipe at the entrance of the orifice, and d_0 the orifice diameter.

The mathematical statement of the fact that no energy is created within the orifice is

$$\frac{V_1^2}{2g}+144\,p_1v_1+Jc_v(T_1-T_0)=144\,p_0v_0+\frac{V_0^2}{2g}$$

Since $144\,p_1v_1=RT_1$ and $144\,p_0v_0=RT_0$ where $R=J(c_p-c_v)$ this reduces to

$$\frac{V_0^2}{2g}\left(1-\frac{V_1^2}{V_0^2}\right)=Jc_p(T_1-T_0)$$

As is usual in similar cases the expansion in the orifice occurs adiabatically, so that we have the relations

$$T_0/T_1=(p_0/p_1)^{\frac{K-1}{K}} \text{ and}$$

$$v_1/v_0=(p_0/p_1)^{\frac{1}{K}}$$

We also have

$$V_1/V_0=v_1d_0^2/v_0d_1^2$$

Hence

$$V_0=\sqrt{\frac{2g\,Jc_p\,T_1\left\{1-(p_0/p_1)^{\frac{K-1}{K}}\right\}}{1-(p_0/p_1)^{\frac{2}{K}}(d_0/d_1)^4}} \quad (1)$$

We suppose the velocity V_1 in front of the orifice so small that it is negligible. Therefore the denominator above is so close to unity that it may be omitted, giving

$$V_0=\sqrt{2g\,Jc_p\,T_1\left\{1-(p_0/p_1)^{\frac{K-1}{K}}\right\}}$$

Taking $g = 32.16$, $J = 778$, $c_p = .238$ and $k = 1.41$ for air, this expression becomes

$$V_0=109.2\sqrt{T_1\left\{1-(p_0/p_1)^{.29}\right\}} \quad (2)$$

This gives the "spouting velocity," or velocity as the air leaves the orifice, in feet per second where T_1 is the absolute Fahrenheit temperature (ordinary Fahr. + 460), and p_1 the absolute pressure of the air just before it enters the orifice, and p_0 is the absolute pressure of the region into which the air discharges.

As is customary in compressed-air work, let us measure the discharge from the orifice in cubic feet of "free air" per second. A cubic foot of free air is a unit of weight just as a pound, but smaller, being that weight which, if at 14.7 pounds per square inch absolute pressure and 520 degrees absolute temperature, would have a volume of 1 cubic foot. One pound of air is the same as 13.092 cubic feet of free air. Let the discharge measured in such units be D. Then since the discharge is actually at p_0 and T_0, instead of 14.7 and 520, the volume actually discharged will be

$$D \times \frac{14.7}{p_0} \times \frac{T_0}{520}, \text{ or } \frac{14.7}{520} D \frac{T_1}{p_1} \left(\frac{p_1}{p_0}\right)^{\frac{1}{K}}$$

cubic feet. Let A be the orifice area, in square feet. Then the volume discharged is also given by $c\ A\ V_0$, where c is the coefficient of discharge. Substituting the value of V_0 from (1) we have

$$D = \frac{520}{14.7} \sqrt{2g\, J c_p} \times cA \sqrt{\frac{p_1}{T_1}} \times \sqrt{\frac{(p_0/p_1)^{\frac{2}{K}} - (p_0/p_1)^{\frac{K+1}{K}}}{1 - (p_0/p_1)^{\frac{2}{K}} (d_0/d_1)^4}} \quad (3)$$

As before, we suppose the entrance velocity negligible, so that the denominator can be omitted, since it is very close to unity. Substituting numerical values for air, we have the following

FINAL FORMULA,

for the discharge of air through an orifice into a region where the pressure is greater than half the initial pressure. (4)

$$D = 3860\, c\, A \frac{p_1}{\sqrt{T_1}} \sqrt{\left(\frac{p_0}{p_1}\right)^{1.42} - \left(\frac{p_0}{p_1}\right)^{1.71}}$$

This formula is only accurate when the velocity at the entrance to the orifice is negligible. In order to exactly take account of the entrance velocity, the right hand member above should be divided by

$$\sqrt{1 - (p_0/p_1)^{1.42} (d_0/d_1)^4}$$

The notation used in this formula is:

D = discharge through the orifice, in cubic feet of free air per second. (A cubic foot of free air is .07638 pound, and is such that it occupies 1 cubic foot if at 14.7 pounds absolute pressure, and 520 degrees absolute Fahr. temperature.)

c = coefficient of discharge (later shown to be about .942 for moderate pressures).

A = orifice area, in square feet.

p_1 = absolute pressure of air entering the orifice, pounds per square inch.

T_1 = absolue Fahr. temperature of air entering the orifice (ordinary Fahr. + 460 degrees).

p_0 = absolute pressure of region into which the air discharges, in pounds per square inch. This is usually atmospheric pressure, and is found by multiplying the corrected barommeter reading in inches of mercury by .4912.

d_0/d_1 = ratio of orifice diameter to diameter of pipe at entrance to orifice. If the entrance diameter is greater than three times the orifice, the error due to neglect of entrance velocity is less than one-half of 1 per cent. for the average value of the pressure ratio, .75.

DESCRIPTION OF APPARATUS.

The orifice used is shown in Fig. 1. As already stated, the relative proportions are due to the Massachusetts Institute of Technology. The arrangement of apparatus is shown in Fig. 2. The orifice A was preceded by a straight pipe B 3 inches in diameter and 6 inches long. This was provided so that the air could assume a uniformly distributed negligible velocity. The orifice diameter being 1 inch, the ratio of diameters is ⅓. An average value of the pressure used in the experiments is 6 pounds gage, so that the pressure ratio is 14.7/20.7. The correction factor necessary to take account of the

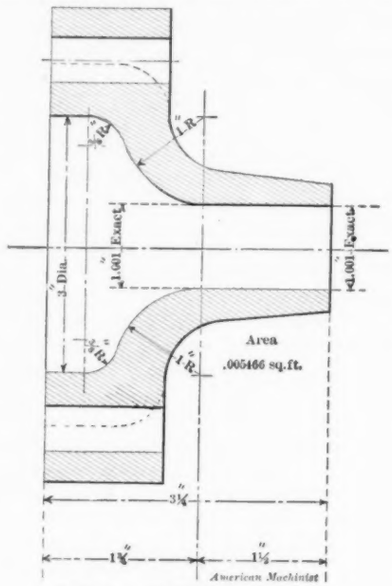


FIG. 1. SECTION OF ORIFICE.

entrance velocity then comes out as 1.003. That is to say, the formula (4) is in error 3-10 of 1 per cent. This is insignificant for the present work, and the entrance velocity is therefore negligible.

The pressure at the orifice was measured by means of a mercury column connected to the region of negligible velocity as shown. This mercury column consisted of a glass tube with a reservoir at the base. The reservoir was of large area compared with the area of the tube, so that the mercury level in the reservoir was practically constant. The scale divisions were, however, reduced proportionately from the theoretical value to account for the variation of the zero level. The scale was graduated to read directly in pounds per square inch.

Opposite the hole where the pressure gage was attached, was a thermometer which gave the orifice temperature. This entered the wall of the pipe through a small stuffing box, so that the bulb was directly exposed to the air being measured. The orifice pressure was held constant by means of the throttle valve C. The mercury column was so placed that it could be easily read by the attendant at the valve. After some practice, the mercury column could be held at an almost absolutely constant pressure during a run. The size of the valve was found an important factor, and a standard 2-inch angle valve was finally determined upon. Too large a valve could not be delicately adjusted, and too small a valve required too rapid adjustment, besides requiring a run to be ended before the tank pressure fell nearly to orifice pressure. A piece of pipe was provided between valve and orifice entrance in order to eliminate any eddies which might have been set up by the throttle valve.

The tank was a large cylindrical steel tank, placed horizontally. An ordinary pressure gage of the Bourdon spring type was directly connected to it. This gage was especially selected for constancy, and was subdivided to read to a single pound. Readings were made to 1-10 pound by estimation. A single thermometer E was placed at the center of the length of the tank, entering the wall through a stuffing box, so as to expose the bulb directly to the air. This thermometer (as well as the one measuring the orifice temperature) was especially quick reading, so as to be able to follow the temperature changes. The use of a single thermometer to measure tank temperature was decided upon after a number of runs had been made with ten thermometers systematically distributed over the surface of the tank. The thermometer E was found to read very close to the average temperature of the ten, so that the others were thereafter omitted. The thermometer E projected within, so that the bulb was about three inches from the tank wall.

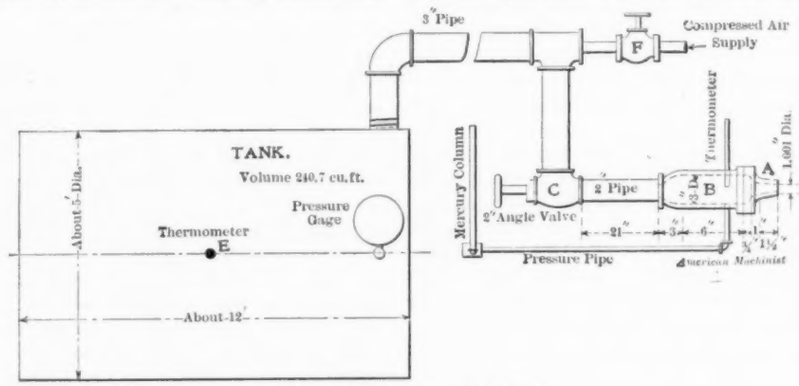


FIG. 2. DIAGRAM OF APPARATUS.

During the time of discharge the air in the tank would theoretically expand adiabatically. As the compressed air admitted to the tank was slightly above atmospheric

temperature, the final temperature would theoretically be quite low. During the discharge the tank thermometer fell very rapidly, but did not nearly reach the theoretical adiabatic temperature. This indicates that heat from the atmosphere was added through the tank walls. As the total time of discharge was comparatively large, there was ample time for considerable addition of heat in this manner. However, the inner core of the air in the tank could hardly be as warm as the layers next the walls. Therefore it is quite possible that the tank thermometer, placed as indicated, did not give correct instantaneous values of the average tank temperature. Hence, the volume of air in the tank would be computed incorrectly. It was thought that the average thermometer readings might differ as much as 10 degrees from the true value. As the absolute temperature is about 500 degrees, this would correspond to an error of about two per cent. The whole work could, therefore, be in error by this amount. It is believed that this error does not exist, but of course this cannot be stated with certainty.

At any rate, the measurement of the instantaneous value of the average tank temperature during the discharge is the weak point in the work. It would probably have been much better if the tank had consisted of a number of tubes, say, of 10 or 12 inches in diameter, instead of a single large tank. Then the addition of heat through the walls would have been more rapid, and the thermometers could also be placed in the central cores. Of course, the larger the reservoir the longer the runs, and more nearly isothermal the expansion. The reservoir used in the present case was the largest one available.

Compressed air was supplied from an adjacent plant at the valve *F*. Two valves were provided, so as to insure that there was no leakage. The maximum safe pressure for the tank was 110 pounds gage, and this was therefore the pressure to which it was filled. The air still retained some of the heat of compression, so that at the beginning of a run the tank temperature was above atmospheric temperature.

Run No. 5. Date May 13, 1904. Date of Curve Sheet giving gage calibration, 5–16.
Barometer, 29.72 inches, 14.6 lbs. per sq. in. Orifice pressure, 6 lbs. gage, 20.6 lbs. abs.

Time in Sec.	Tank press.	Correct'd press.	Abs. press.	Tank temp.	Abs. tank temp.	Cu. ft. free air in tank.	Orifice temp.	Abs. orifice temp.	Sq. root abs. orifice temp.
1	2	3	4	5	6	7	8	9	10
0	107	107.9	122.5	104	564	1850	69.0	529	23.00
15	102	102.5	117.3	102	562	1777	79.1	539.1	23.22
30	95	95.7	110.3	99	559	1681	83.0	543	23.30
45	90	90.8	105.4	96	556	1612	82.0	542	23.28
60	85	85.8	100.4	92	552	1548	81.0	541	23.26
75	80	80.4	95.0	87	547	1478	79.0	539	23.22
90	74.5	75.2	89.8	81	541	1410	77.9	537.9	23.19
105	70	70.6	85.2	77	537	1350	76.8	536.8	23.17
120	65	65.4	80.0	70.5	530.5	1281	75.7	535.7	23.14
135	61	61.1	75.7	67	527	1222	74.7	534.7	23.12
150	57	57.1	71.7	62.5	522 5	1169	72.8	532.8	23.08
165	52	52.1	66.7	57.5	517.5	1098	68.0	528	22.98
180	47	46.9	61.5	55	515	1016	65.5	525.5	22.92
195	43	42.6	57.2	51	511	952	63.0	523	22.87
210	40	39.5	54.1	49.5	509 5	905	62 1	522.1	22.85
225	37	36.3	50.9	47	507	854	61.0	521	22.83
240	32	31	45.6	44	504	771	60.2	520.2	22.80
255	28	26.8	41.4	41.5	501.5	701	59.8	519.8	22.79
270	25	23.6	38.2	39	499	652	59.0	519	22.78
285	21.5	19.9	34.5	37	497	590	58.7	518.7	22.77
300	18	16.2	30.8	35	495	530	57.8	517.8	22.75
315	13	11	25.6	33	493	442	57.0	517	22.74
328	11	9	23.6	31	491	409	56.0	516	22.72

Results.—Mean sq. root abs. orifice temp..... 22.99
Mean abs. orifice temp..... 528.6
Mean orifice temp. ..... 68.6° F.
Corrected values of cu. ft. free air in tank, from curve,
Initial.....1806
Final..... 389
Diff.....1417
Discharge, cu. ft. free air per sec. Actual..... .....4.32
Theoretical..... ....4.55
Coefficient of discharge..... 949

TABLE I. SAMPLE LOG SHEET.

Nozzle press., gage.	No. of run.	Date.	Baro., lbs. sq. in.	Orifice press., abs.	Mean orifice temp.	Mean sq. root abs. orifice temp.	Total dis. cu. ft. free air.	Length of run in sec.	Discharge, cu. ft. per sec.		Coefficient of discharge.
									Actual.	Theoretical.	
1	2	3	4	5	6	7	8	9	10	11	12
4	21	5-24	14.65	18.65	61.5	22.83	1373	390	3·52	3.73	.937
4	22	5-24	14.65	18.65	59.9	22.80	1404	390	3·60	3.76	.956
4	23	5-24	14.65	18.65	59.0	22.78	1439	405	3.55	3.77	.941
4	24	5-24	14.65	18.65	58.2	22.76	1446	405	3·57	3.77	.947
5	18	5-23	14.57	19.57	54.9	22.69	1281	315	4.06	4.21	.964
5	19	5-23	14.57	19.57	56.9	22.73	1263	315	4.00	4.21	.950
5	20	5-23	14.57	19.57	56.6	22.73	1133	285	3.97	4.21	.943
6	1	5-12	14.7	20.7	54.8	22.69	1025	240	4.27	4.62	.924
6	2	5-12	14.7	20.7	58.9	22.78	947	225	4.21	4.61	.913
6	3	5-12	14.7	20.7	61.2	22.83	1040	240	4.34	4.59	.946
6	4	5-13	14.6	20.6	63.6	22.88	1385	320	4.33	4.56	.949
6	5	5-13	14.6	20.6	68.6	22.99	1417	328	4.32	4.55	.949
6	6	5-13	14.63	20.63	64.9	22·91	1354	312	4.33	4.56	.949
7	7	5-18	14.6	21.6	51.0	22.60	1032	225	4.59	4.99	.919
7	8	5-18	14.5	21.5	50.6	22.59	1050	225	4.66	4.94	.943
7	9	5-18	14.5	21.5	63.1	22.87	1030	225	4.58	4.87	.939
7	10	5-18	14.5	21.5	64.1	22.89	1026	225	4.56	4 87	.936
7	11	5-18	14.5	21.5	58.1	22.76	1037	225	4.60	4.93	.935
8	12	5-20	14.5	22.5	48.2	22.54	925	180	5.14	5.31	.968
8	13	5-20	14.5	22.5	48.8	22.55	922	180	5.12	5.33	.960
8	14	5-20	14.5	22.5	63.0	22.87	950	195	4.87	5.23	.931
8	15	5-20	14.5	22.5	66.5	22.94	872	180	4.84	5.21	.929
8	16	5-20	14.5	22.5	67.4	22.96	874	180	4.85	5.21	.931
8	17	5-20	14.5	22.5	66.5	22.94	815	165	4.94	5.22	.946

Average value of coefficient of discharge..... .942

TABLE II. TABULATION OF RESULTS.

METHOD OF MAKING A RUN.

In the following description reference will be made to the sample log sheet, Table I, and the diagram, Fig. 2. During a run columns 1, 2, 5 and 8 were filled in from observations. The other columns were computed afterward.

The throttling valve *C* was closed and the compressed-air admission valves *F* opened and the tank filled. The valves *F* were then tightly closed and discharge through the orifice begun by opening the throttling valve *C*. The valve *C* was opened wide enough to bring the orifice pressure to the value intended to be held during the run. This was done as rapidly as possible, in order that the run should be as long as possible. When the desired pressure was reached and the attendant had control of the orifice pressure, he gave the signal that the run had begun. An observer stationed so as to be able to read the orifice temperature held a stop watch, and at this signal started it. Thereafter this latter observer gave the signals for readings every 15 seconds. The air from the tank was in the meantime being discharged through the orifice, so that the tank pressure gradually fell. As already stated, the orifice pressure was held almost absolutely constant by the attendant at the throttle valve *C*. Finally the tank pressure approached close to the orifice pressure, and the throttle valve had to be opened very rapidly. When the attendant considered that he would no longer be able to hold the orifice pressure constant he gave a final signal. The stop-watch was then stopped, so as to give the total length of the run. This averaged about 5 minutes. The signals for readings were given every 15 seconds, as stated, except the last one. The final reading of the stop-watch gave the last interval. The proper values for the time were inserted in column 1. At each signal an observer took the instantaneous reading of the tank pressure, and immediately afterward of the tank temperature, and at once recorded them directly on the log sheet in Columns 2 and 5. He then stationed himself at the pressure gage, ready to read at the next signal. Another observer, who also held the stop-

watch, read the orifice temperature, which he recorded on a separate sheet, afterward copying the readings on the log sheet, in Column 8.

After giving the first signal, the attendant at the throttle valve closed it, and the tank was filled and another run begun.

As may be imagined, the three men making the run had to be very alert, and considerable practice was necessary before they could read with accuracy. A number of runs were made and discarded before proper proficiency was obtained.

CALIBRATION OF APPARATUS.

The orifice diameter was measured by means of a flat gage, ground until it exactly fitted, and then measured with a precision micrometer. The mercury column used to measure the orifice pressure was compared with a U tube. The difference of level of the legs of the U tube was measured directly by means of a steel scale. .49 was used as the density of mercury at atmospheric temperature, in pounds per cubic inch, so that 1 pound on the mercury column should correspond to $\frac{1}{.49}$ inch of the U tube. The mercury column was found almost exactly correct.

The thermometers for measuring orifice and tank temperatures were calibrated by comparison with a standard thermometer at several points, and also checked at 32 degrees by melting ice. They were found correct within a degree, which was considered accurate enough for the work.

The pressure gage used to measure the tank pressure was calibrated after every third run or thereabouts, by comparison with a dead-weight gage tester. The points from two successive calibrations were plotted on co-ordinate paper, and a line drawn to best represent the points. This was used to give the corrected pressure for all runs between the two calibrations.

The tank volume was ascertained by direct measurement. A light wooden frame was constructed like a large letter U, which was used as a caliper to obtain the diameter. A metal point was used as anvil in one leg, and a steel scale was arranged to slide in the other leg. A fixed zero mark was placed exactly opposite the end of the scale when it indicated 5 feet, by use of a carefully tested standard steel length gage. A similar caliper indicating 12 feet and over was made for obtaining the length of the tank. By means of these calipers the outside length and diameter of the tank were found in a large number of places and the averages found. The thickness of the plate was allowed for and deduction made for laps and rivet heads, giving a computed value for the tank volume. On account of the great length of the measurements taken, compared with the greatest possible error, this method was extremely precise. For instance, suppose an error of 1-16 inch were made in the average length, which was about 12 feet. This would give an error in the total volume of 1-16 ÷ 144, or about 1-20 of 1 per cent. This is of course negligible.

LEAKAGE.

The whole system was made as nearly tight as possible by means of careful calking. Frequent tests were made between the runs by filling the system with compressed air, closing all valves, and observing the drop of pressure. In all cases the pressure fell so slowly that the leakage was shown to be insignificant.

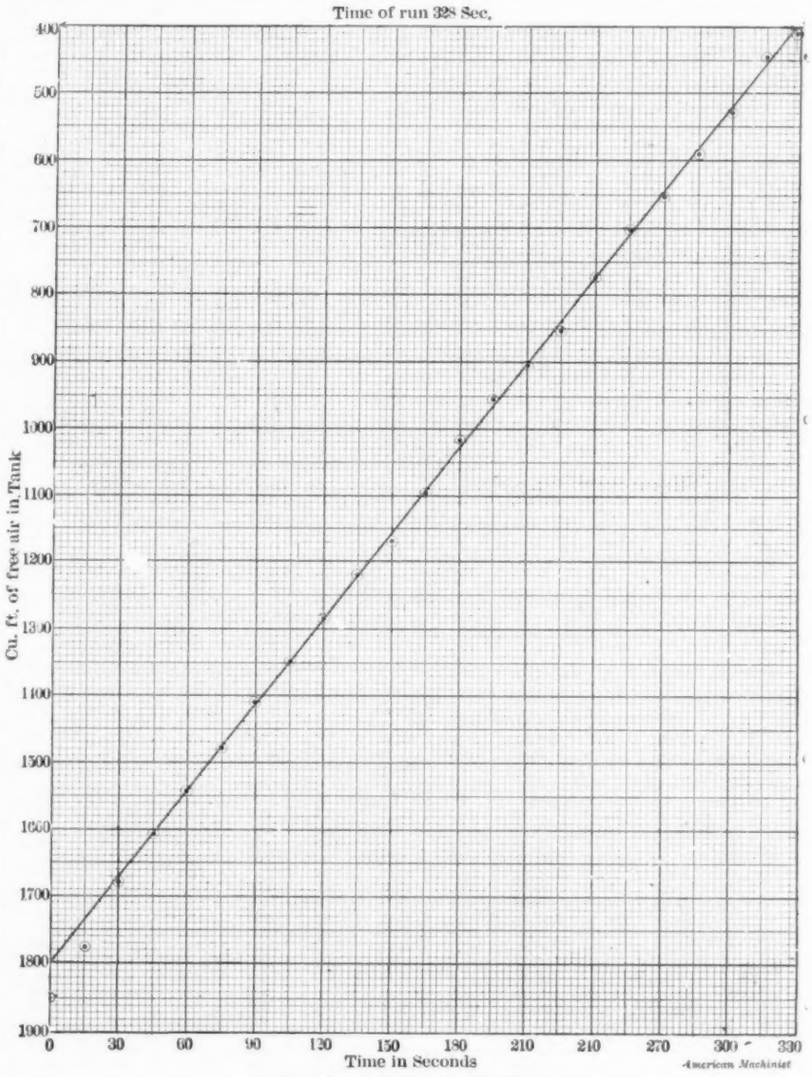


FIG. 3. SAMPLE CURVE SHEET.

For example, in one leakage run, which is an average one, the pressure dropped from 106 pounds gage to 42 pounds gage in forty-eight hours.

The leaks in any system such as the present are equivalent to a single hole of a definite area which may be called the "leakage orifice." The air leaks just as it would flow out of this leakage orifice according to the ordinary laws.

The size of the leakage orifice for a system may be computed from a leakage run by means of the following formulas, whose deduction we have not space for.

P_1 = Absolute pressure at beginning of leakage run.

P = Absolute pressure at end of any length of time, t minutes.

V = Total volume, in cubic feet.

T = Average absolute Fahr. temperature during leakage run.

f = leakage orifice, in square feet.

$$f = .00135 \frac{V}{\sqrt{T}} \frac{log_{10} P_1 - log_{10} P}{t}$$

The average value of the last fraction should be found from several corresponding values of P and t taken at various times during the run. It can be easily found by plotting $log._{10} P$ against t and finding the inclination of the straight line representing the points.

The air wasted by leakage during any interval when the system is in regular use, is found by substituting the value of the leakage orifice in the usual formula for discharge of air into a region below the critical pressure.

P^1 = Average absolute pressure.

T^1 = Average absolute Fahr. temperature.

f = leakage orifice, square feet.

D = discharge in "cubic feet of free air (14.7 pounds and 60 degrees Fahr.) per minute."

$$D = \frac{60300\, f P^1}{\sqrt{T^1}}$$

The leakage orifice for our system comes out as .0000016 square feet, and the air lost by leakage during an average one of the regular runs, as 1.3 cubic feet of free air. This is about 1-10 of 1 per cent. of the total air discharged in a run, which is, of course, negligible.

METHODS OF COMPUTATION.

The log sheets, shown by Table I, were received from the observers with columns 1, 2, 5 and 8 filled out. Column 3 was filled out by direct reading from the proper gage calibration curve. Column 4 was filled by adding the barometer reading reduced to pounds per square inch to column 3. Column 6 was filled by adding 460 to column 5.

The number of "cubic feet of free air" (*i. e.*, air at 14.7 pounds and 60 degrees) in the tank at any instant is obviously

$$2\,10.7\,\frac{p}{14.7}\,\frac{520}{T} \text{ or } 8514\,\frac{p}{T},$$

where p is the absolute pressure and T the absolute temperature in the tank at the instant considered. Column 7 was therefore filled out by dividing 8514 by the value from column 6 and multiplying by the value from column 4. Column 9 was found by adding 460 to column 8, and column 10 was found from a table of square roots.

The rate at which air left the tank, that is, the rate at which the figures in column 7 decrease, is of course the rate at which the orifice discharged. Referring to the formula for discharge (4), it will be seen that the discharge from the orifice depends upon the orifice pressure and the square root of the absolute orifice temperature. As will be seen from column 10, the square root of the absolute orifice temperature varied but little during a run, and may practically be considered as constant. The orifice pressure was actually held constant during a run, as stated. Therefore the rate of discharge was constant during a run, and the value in column 7 should decrease in regular progression.

The quantity of air in the tank at each instant was plotted by using values from column 1 as abscissas and corresponding values from column 7 as ordinates, as shown in Fig. 3. Since the rate of discharge is constant, the points should lie exactly on a straight line. As will be seen, they do so very nearly. There are, of course, slight differences due to errors of observations.

As stated, the square root of the absolute orifice temperature varies slightly during a run, causing a proportionate variation in the rate of discharge. The effect of this is to cause the points, such as shown in Fig. 3, to be on a line with a very slight curve rather than a straight line. The points for one run were corrected for this variation, as described below, but the correction was absolutely insignificant, and was therefore omitted throughout. The total quantity of air discharged in a whole run is proportional to the average value of the square root of absolute orifice temperature; that is, the mean of the numbers of column 10, Table 1. However, the total quantities of air discharged from the tank up to any intermediate instant, given by subtracting each of the values of column 7 from the first value, are proportional to the average value of the square root of the absolute orifice temperature from the beginning of the run to be the instant considered. This average would be found by adding all of the values in column 10 from the beginning to the reading considered, and taking the mean. Hence, if we subtracted each reading of column 7 from the first reading and divided by this latter average, and multiplied by the average of the whole of column 10, we would have values which would occur if the discharge were absolutely constant throughout, due to a constant orifice temperature. The values thus corrected should lie in an absolutely straight line. This correction would alter the values near the middle of column 7 by about 3, and would not change the values at either end. Hence, the line of Fig. 3 should actually be bowed in the center by about 3-10 of the smallest division. This is inappreciable, and a straight line represents the points just as well. Hence, the orifice temperature is considered as constant throughout, and such that the square root of the absolute value is the same as the mean of column 10.

The intersection of the line of Fig. 3 with the vertical lines representing the times at the beginning and end of the run give values of the initial and final "cubic feet of free air in the tank," more accurate than the first and last readings of column 7. The values are more accurate, since they are read off a smooth curve, and are corrected by the influence of the other readings. In fact, the readings of the initial and final values of air in the tank, from the curve, have as much weight as if all of the readings of the run were taken at these points. In other words, all of the readings of a run are taken into account in finding the rate of discharge from the curve, so that the coefficient of discharge for each run is found from the mean of a large number of readings.

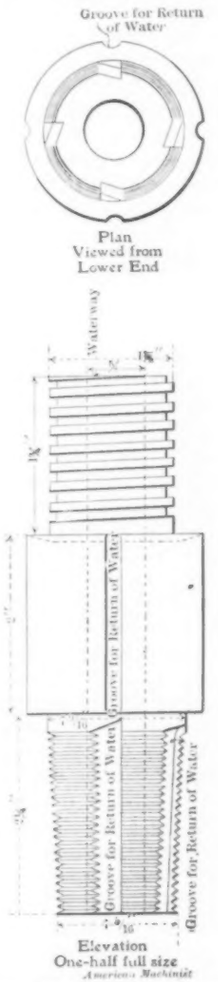
The corrected values of the initial and final air in the tank were read from the curve, as stated, and the difference between them found and divided by the time. The quotient is the actual discharge from the orifice in cubic feet of free air per second. The "theoretical" discharge was then computed from formula (4) by omitting the co-efficient. The ratio of the actual to the theoretical discharge gave the co-efficient of discharge.

A tabulation of the particulars of all of the runs, and the co-efficients obtained, is given in Table II. The final result is that the co-efficient of discharge is .942, to a degree of accuracy sufficient for most engineering purposes, for ordinary temperatures and moderate pressures.

"The Recovery of a Diamond-Crown From a Deep Bore-Hole."*

BY CUTHBERT BARING HORWOOD, ASSOC. M. INST. C. E.

The following is a description of work which came under the author's notice during the latter part of the year 1903.



THE TOOL THAT SEIZED THE DIAMOND CROWN.

With the object of exploring the Van Ryn Reef, boring operations were commenced in 1902 on a farm on the far East Rand, about thirty-three miles from Johannesburg. When work had proceeded for more than a year, and the bore-hole had reached a depth of 3,233 feet, the bit became jammed, and the rods were con-

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sequently withdrawn. When the last rod had been removed, the core-barrel, which was 40 feet in length, was drawn up. On its arrival at the surface it was found that the core-barrel contained no core, and that the shell and diamond-crown were missing.

The shell is a piece of steel tubing, about 4 inches in length, containing the spring which holds the core in position in the barrel, and it forms the connecting piece between the core-barrel and the bit or crown. The thread at the end of the core-barrel, which screws into the shell, had broken off flush with the top of the shell. The core, with the exception of about ½ inch at the bottom end, was recovered without difficulty, and the shell was recovered by means of a tap, cut short in order to insure its not being too long for the threaded tapered portion to grip the shell. When the shell was brought up, it was found that the crown had broken off from it, flush with the end of the shell, leaving its threaded portion within the shell.

In order to recover the crown, a special tap was made in Johannesburg. This tool was 6 inches in length, of which 1¾ inches were threaded to screw into the end of the bottom rod; the next 2 inches consisted of a shoulder, 2 1-64 inches in outside diameter, to guide the tool, and contained four longitudinal grooves or waterways to allow the water to pass up outside round the edge of the bore-hole; and the remaining 2¼ inches consisted of a threaded tap, tapered from 1 9-16 inches to 1 5-16 inches in diameter. The tool was not solid, being ⅝ inch in inside diameter. It was made of steel, the end of the taper being softened to permit of diamonds being set in it. Four small diamonds (about 1½ carat in all) were set in the end, in order to cut, within the crown, through and beyond the rock in which it was presumably imbedded. By the use of this tool the crown was speedily recovered. All the diamonds were found to be intact; there were eight diamonds on the face of the crown, four inside and four outside, and also four inferior diamonds round the outside of the bit, to keep the hole sufficiently large to insure easy working, and to prevent the bit from becoming jammed. The carbons, when recovered, weighed 17 53-64 carats, and were valued at more than £230, or £13 per carat; moreover, having been used, their quality had been tested, and reliance could therefore be placed upon them.

When the crown was recovered, it was found to have been very badly burned, and to be worn down to only ½ inch in depth, a new crown being ¾ inch in depth, neglecting the threaded portion. The bit having first broken off flush with the end of the shell, the two parts had been grinding against each other. As it was afterward discovered that three rods had split at a depth of between 1,700 and 2,000 feet from the surface, it was concluded that the pressure-water, which is forced down through the rods and returns through the clearance-space between the outside of the rods and the side of the bore-hole, had escaped where the split occurred, and so had found a quicker and easier course to the surface. Thus no circulation of water had been taking place round the bit to keep it cool and to carry away the cuttings. The bit would thus quickly become jammed, and, probably weakened by overheating, would be unable to withstand the torsion to which it was subjected, and would therefore break. The fracture occurred in the lower quartzites of the Upper Witwatersrand Beds.

The drill was a Sullivan machine, warranted to bore to a depth of 4,000 feet; the rods used were of steel, of English manufacture, in 10-foot lengths, which at this depth were unscrewed in 50-foot lengths for removal. The core-barrel was in two 20-foot lengths.

The risk involved in the accident was that the hole might have to be abandoned entirely. This would have meant: (1) A year's work wasted; (2) probably nine months' delay before the same depth could again be reached in another hole; (3) loss of the total amount spent up to that time (about £8,000); (4) loss of £230 worth of diamonds; (5) loss owing to depreciation of plant and machinery for one year; and other incidental losses.

Industrial Use of Alcohol in Germany.

U. S. Consul General Mason, of Berlin, Germany, has prepared a special report embodying many interesting and important details of information about the industrial uses of alcohol. There seems to be a prevalent impression that in Germany alcohol is made from garbage or "any old stuff." The report says this is a mistake. Aside from the small amount that is produced for drinking and medicinal purposes from prunes, grapes, cherries and other fruits, the great sources of alcohol for industrial and other uses are potatoes, grain and the molasses derived as a secondary product from the manufacture of beet sugar. The following are the amounts produced last year in hectoliters (26.420 gallons): Potatoes, 3,045,605; grain, 692,483; beet molasses, 116,211; total, 3,854,299 hectoliters (101,823,470 gallons).

Several years ago, when the motor vehicle for military and industrial purposes began to assume a new and extraordinary importance, the German Government became impressed with the necessity of building motors which could be operated with some liquid fuel that could be produced in Germany, in the event that through the chances of war or other cause the supply of imported benzin and other petroleum products should be cut off. Alcohol offered the solution of this problem and all the influence of the Government was exerted to encourage its production and its more extended use for motor purposes.

The net result of all this systematic effort has been to extend so rapidly the use of alcohol for heating, lighting and chemical manufacturing purposes that when the drouth of last summer reduced somewhat seriously the output of potato alcohol the previous surplus was exhausted and the price advanced until alcohol became too costly for economical use as fuel for motors.

While the general use of alcohol for industrial purposes, heating, lighting and a vast range of chemical and other manufacturing purposes, has steadily increased in Germany, the percentage of the whole product that is used for motor purposes is relatively small and, so far from increasing, is said to be rather diminishing, though to just what extent it would be difficult to prove. A few Germans, from patriotic motives, use alcohol for driving automobiles, freight wagons, motor boats and farming machinery. A single department store in Berlin, which ordered its equipment of delivery wagons four years ago, during the height of the alcohol-promotion movement, still consumes yearly 80,000 liters (about 19,000 gallons) of alcohol for driving these wagons, but mixed, for greater efficiency, with about 15 per cent. of benzol.

It has been found by elaborate tests that the economy of alcohol as a fuel for gas motors is largely increased by its being carbureted through admixture with a certain percentage of benzol or other product of mineral oil. For a time it was believed that this admixture of benzol could not be safely carried beyond 20 per cent., but more recent experience has shown that a mixture of equal parts of alcohol and benzol can be used, especially in large motors, with entire safety and economical results. For automobile purposes the usual proportion is now about 30 per cent. of benzol or gasolene, but at the present cost of alcohol it cannot compete on the score of economy with mineral hydrocarbons in a country where they are either produced or imported free of duty.

There are now in use in Germany something more than 2,000 stationary or portable alcohol engines, exclusive of the spirit motors used in automobiles. They consumed in the fiscal year 1903-1904 36,000 hectoliters (951,120 gallons) of denatured alcohol. Owing to the enormous potato crop of 1901 and the consequent overproduction of alcohol, the denatured spirit of the grade used for motors could be bought in 1902-1903 in any quantity for 15 to 17 cents per gallon, but for reasons hereinbefore stated this price rose in 1904 to 35 marks per hectoliter (about 31.5 cents per gallon), at which figure it became more expensive as motor fuel than gasolene.

Such is substantially the situation in

Germany. The manufacture and industrial uses of alcohol were never so great, so important and so varied as now. This general increase in the fiscal year 1903-1904, compared with the preceding year, was, according to the annual report of the Centrale, more than 2,900,000 gallons. But notwithstanding the fact that all the leading German manufacturers of gas engines and motor vehicles make alcohol motors that are technically successful, the question of price is the controlling consideration, and of the whole 3,854,299 hectoliters (101,823,470 gallons) of spirits produced during the last year only about 1 per cent. was used for motor purposes.

Stresses in Contractors' Tripod Legs.

BY HARRY GWINNER.

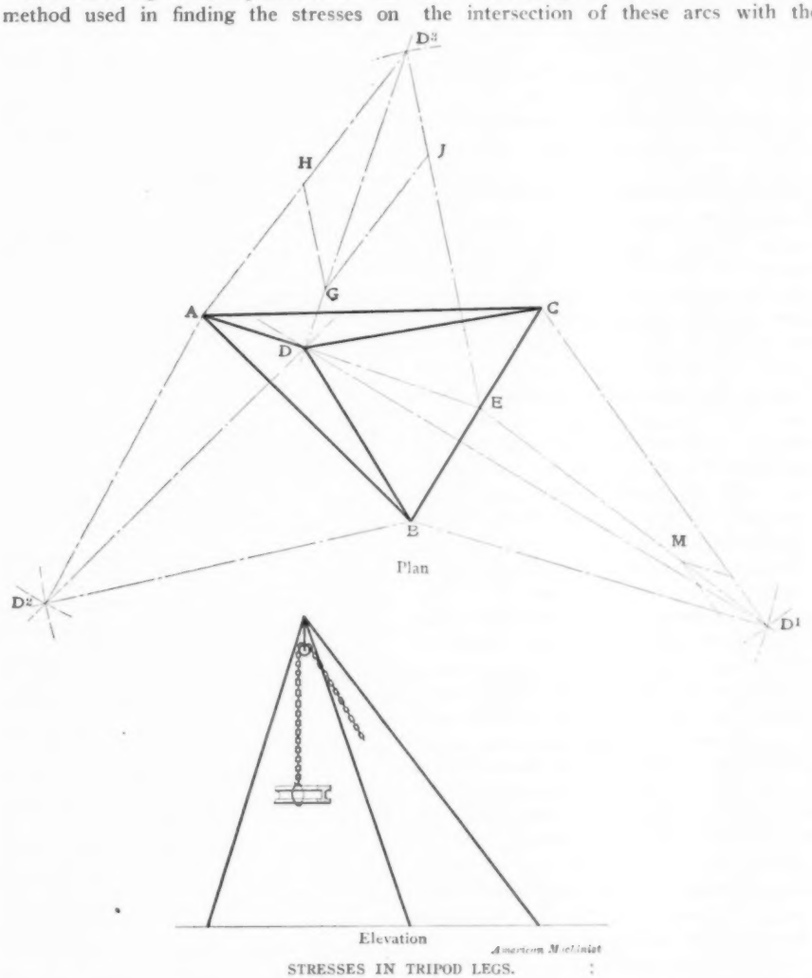
The following is an explanation of the method used in finding the stresses on three-legged structures, such as sheer legs and tripods.

In the plan, the vertex of the legs is at D. The lengths of the legs are $DA = 8$ feet, $DB = 9$ feet, and $DC = 9\frac{3}{4}$ feet. The ends when spread out form a triangle, whose sides are $AB = 7$ feet, $BC = 6\frac{1}{2}$ feet, and $AC = 8$ feet. To find the compressive stress in each leg when a weight of 4 tons is hung from the vertex D.

In problems of this nature, replace any two of the legs by an intermediate leg in the same plane with them, and in such a way that if the load be supported by it and the third leg of the structure, the stress in this third leg will not be altered.

The proper position of the intermediate leg to obtain this result will be in a vertical plane containing the third leg and the weight, and is represented on paper by the line of intersection of this plane with the plane of the other two legs which the intermediate leg is to replace. So much for general principles.

Now for the solution: Construct the triangle ABC formed by the feet of the tripod. With A as a center and the true length of leg DA as a radius, strike an arc, and with B as a center and true length of DB as a radius strike another are intersecting the first at D^2. Connect the intersection of these arcs with the points A and B, and the triangle AD_2B is formed. Similarly, draw the triangle BD^1C, using the true lengths DB and DC to get the vertex D^1. These lengths are given in the problem as stated in the second paragraph.



STRESSES IN TRIPOD LEGS.

From D^2 draw an indefinite perpendicular to AB, and from D^1 an indefinite perpendicular to BC. The intersection of these two will give the point D (the plan of the vertex of the tripod). Connect D with the points A, B and C, and the plan is complete.

Then pass a vertical plane through any one of the legs. To do this, produce or extend the leg selected until it intersects the opposite side of the triangle of the base. (As the elevation is not required, it will not be used at all.) In the figure, AD is produced until it intersects BC; which will be in the point E. The line AE is the line of intersection of the desired vertical plane (which contains the third leg) and the plane of the other two legs. The line AE also represents the intermediate leg which replaces the two legs DB and DC. This vertical plane then contains the third leg, the weight and the intermediate leg. Connect E with D^1, and the true length of this intermediate leg is given by the length D^1E.

Draw DD^3 perpendicular to ADE and make $ED^3 = ED^1$, and connect D^3 with A. By doing this, we are able to represent accurately, or to scale, that portion of the vertical plane which contains the third leg, the weight of 4 tons and the intermediate leg. On DD^3 lay off to a suitable scale $D^3G = 4$ tons, and complete the parallelogram of forces. The stress in AD will be represented by D^3H, and is found to be 2.70 tons, and the stress in the intermediate leg is represented by D^3J, and is equal to 1.70 tons.

By transferring the latter stress to the line D^1E, making $D^1M = 1.70$ tons, and completing the parallelogram, the stresses in CD and BD are found to be 1.00 ton and 0.625 ton respectively.

The elevation was not necessary, but was added to make the drawing complete.

European Methods of Denaturing Alcohol.

In France, alcohol is treated by the addition of 10 per cent. of methylene containing 0.5 per cent. of heavy benzine of dark color and unpleasant odor—a method which diminishes calorific value and increases the fouling of cylinders and valves. Italian motor alcohol, containing about 1 per cent. of benzol, is treated with 8.5 per cent. of impure methylene and 0.66 per cent. of pyridine, and for the sake of distinction the spirit is colored violet by aniline dye. Swiss alcohol contains 5 per cent. of methylene, 0.33 per cent. of pyridine, and 2.2 per cent of oil of acetone, which gives a very disagreeable odor, and an opalescent yellow coloring. In Austria alcohol containing at least 2.5 per cent. of benzol or mineral hydrocarbon, is denatured with only 0.5 per cent. of methylene and a trace of pyridine, and is colored violet. In Germany motor alcohol, containing a minimum of 2 per cent. of benzol, is denatured with 1 per cent. of methylene and a small quantity of pyridine. It is colored violet but not so deeply as in Austrian practice.

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The Bennington Disaster and the Personnel Bill.

The fatal explosion of a boiler of the "Bennington" is causing renewed discussion of the Navy Personnel bill, and many people are discovering now just what Admiral Melville said were the facts about the bill in reports made by him several years ago, while he was yet at the head of the Bureau of Steam Engineering.

Curiously enough just about this time there appears a magazine article (written some time before the "Bennington" disaster) wherein Admiral Dewey is quoted as saying in effect that the Personnel bill is working entirely satisfactorily. It is notorious that it is doing nothing of the kind. The bill was, it is understood, framed by President Roosevelt when he was Assistant Secretary of the Navy, and was the best thing he could devise for the purpose of getting over the difficulty which had arisen over the "Line and Staff fight." In this fight the men who had graduated at Annapolis and who had chosen to specialize in the engineering branch of naval science, instead of the navigation or military branch, asked, simply, that they be given their plain rights—that an engineer officer of a certain grade should have the same privileges and be accorded the same treatment as were claimed and enjoyed by a line officer of the same grade. They asked to be given control of that for which they were responsible, and that it should be made impossible for an upstart fledgling happening to be in temporary command of the deck of a naval vessel to send for and take away from his station a member of the engineer force, placed there by the engineer in charge, without so much as consulting with the engineer or letting him know that the man had been taken away. In other words they asked simply that present day conditions be recognized in the navy and that common sense be applied to its management. "The Line," chiefly through the agency of its clique, opposed doing anything just as long as it possibly could, and for reasons which could not possibly have been based upon a desire for the good of the service. In the meantime the navy lost by resignation a very large proportion of its brightest engineer officers, who found the conditions of the service intolerable and much better ones in private employ.

Instead of placing things upon the basis demanded by the logic of the situation the Personnel bill was devised, which amalgamated the line and staff and provided for assigning certain officers to engineering duties—all of them being supposed to be capable of discharging such duties. It has not worked well, as Admiral Dewey and other line officers have said, but has worked badly, as Admiral Melville and other engineer officers have said, and while we do not yet know and have some fear that the full facts may never be known as to the immediate cause or causes of the "Bennington" boiler explosion, we feel quite sure that it would not have exploded had real engineers been in charge of it, and if it had been operated under conditions that would have been prescribed by competent engineers, acting with free hands.

There are at present about 120 line officers in the navy who may be assigned to engineering duty. Out of these 57 have such rank that they can be assigned to shore duty only. There are about 160 naval vessels of all kinds in commission and so there is $(120 - 57) \div 160 = 0.39$, or considerably less than one-half of one engineer available for each vessel. It is often asserted that graduates of Annapolis are not needed to have charge of naval marine engines at sea; that intelligent machinists are good enough, and experience in the merchant marine is cited to prove this. We think there is something in this contention; or, rather, that there would be if conditions in the navy were or could be made such that the right sort of men would be attracted to and retained in the service. But a really competent marine engineer will not stand much foolishness. He "doesn't have to," and in the merchant marine few commanders think of putting on airs over him or of interfering with him or his men in the discharge of their duties. Is this the case in the navy? Or would it be if naval engineers were kept ashore for real engineering work? Not by a —er—, that is, we wot not. Imagine such a man as is in charge of the engines of our great transatlantic liners taking "guff" from a brass-bound junior officer and being treated as though he belonged to an altogether inferior order, scarcely worthy of notice, and to be trusted with nothing except the carrying out of specific and detailed orders. It is a far cry from the merchant marine, say of Germany (where the chief engineer has a table in the dining saloon at which he presides in the same manner as the captain does at his table, and where it is distinctly understood that the engineer is entitled to the highest respect), to the navy where even if a man has graduated at Annapolis, is as highly educated as any other officer of the vessel and the equal in every respect of any other, he is despised simply because he has to do with greasy engines.

So far as we can see there are just two horns to the present dilemma. Such men as manage the engineer departments of merchant vessels may be employed in the navy, but they must be answerable only to the captain, and to him only for general results, without the least interference from anybody as to details of management. Or, there must be graduates of Annapolis in charge who must be specially trained and who must hold commissions and have such rank and authority as will make their standing unquestioned and

their authority absolute over all for which they are, and should be, held responsible. Unless something is done there will in our opinion be other "Bennington" disasters, and investigations made to show just what particular man may have gone wrong in such a way as to cause that disaster will entirely fail to reach the seat of the difficulty, and will do no good whatever except in so far as they may show that something much more radical must be done.

Reciprocity and Foreign Machine Business.

Fred. A. Geier, president of the Cincinnati Milling Machine Company, sends us an instructive table which he has compiled and which shows that under the new German tariff the cost to German dealers of the milling machines manufactured by the company named will be increased by amounts ranging from $13.87 to $42.60, with an average increase for the whole line of nearly $22 per machine. To this increased cost the dealer will, and of course must, add his margin, so that the cost to the users of the machines will be increased by a still greater amount.

It is obvious that this increased cost will prevent many an American machine being sold in Germany that otherwise would be sold there, and as Mr. Geier is one among the many American machine-tool builders who do not fear foreign competition in machine tools in the American market, he naturally asks why our duty on all lines of machine tools should be kept at 45 per cent., and what effect it can possibly have other than to prejudice foreign buyers and stimulate the enactment of hostile foreign tariffs. He evidently believes that this is a case for a reciprocity arrangement, if nothing more, and says: "I believe that you could do a great service to the machine-tool interests if the AMERICAN MACHINIST would emphasize the importance of this question.

"Unfortunately, there is considerable indifference on the part of many manufacturers on this subject, for the reason that they personally do not have any foreign business. It is clear, however, that the more business the 'other fellow' can do in the foreign field, the greater the demand will be for machine tools from all the builders."

Mr. Geier calls attention to the fact that there are many manufacturers who would be hurt, or who think they would be hurt, by any change in the tariff. These loudly cry out against any proposed change, and Congress is left with the impression that there is practical unanimity among manufacturers upon the subject, and that no change or modification is desired. He thinks those whose business is manifestly injured by the present tariff and its effects have also the right to be heard, and that they should make themselves heard.

Referring to the letters from American machine-tool builders published in our columns in 1902, and in which there was substantial unanimity in the opinions that the tariff on machine tools is not needed; that free raw materials would greatly help American builders, and that labor is as cheap here as anywhere, Mr. Geier thinks that more of such expressions should be heard.

For our part, we hope that American citizens will always and more and more make themselves heard publicly on questions that concern them. That is one of the things that American citizenship means. This is a business matter as well as a public question, and we shall be glad to hear from machinery manufacturers regarding it, no matter what views they may hold upon it.

A Proposition for a Practical Foundry School.

The following proposition was presented at the New York meeting of the American Foundrymens' Association by W. C. Bruce, of Cleveland. It is quite in line with, and a following up of the suggestion of Professor Sweet, in his address before the Engineers' Club, of Syracuse, wherein he remarked that it was probable that a practical school of shop training and instruction could never be established until there was a good shop for sale and some one rich and philanthropic enough to buy and keep it up for the purpose.

Mr. Bruce in introducing his proposition says:

"There are quite a number of technical schools in the country, but I have never yet seen a practical mechanic turned out of that kind of an institution. A foundry school must have a general line of castings to make, so that when the apprentice is turned out, he will have a general knowledge of the business and be able to command wages as a practical molder or core maker. In an ordinary apprenticeship, as it is now carried on, there is no one to give the boy any special instructions, and if he makes a mechanic at all, it is because of his superior natural qualifications along that line. There is no question in my mind but that we could get plenty of young men who would be very glad of an opportunity to learn a business or trade that pays as good wages as the average molder can make, provided he did not have to serve an unreasonable time to do so. I believe that one year's experience in the proper school with the proper instructions would be equal to the present four years' course in the average foundry, and, in fact, six weeks for an ordinary intelligent man should be sufficient for him to learn to turn out good work on 75 per cent. of the work that is made in the ordinary foundry.

"Now the writer has a proposition to make that, should it meet with your favor, will make the establishment of a practical foundry school an assured fact. I have a foundry building practically new, that has a capacity for 30 to 40 tons per day, with two cupolas, electric equipment and everything complete ready to start business. This plant cost $50,000 and is complete in all its details, is located in a town of 5,000 inhabitants, in Ohio, and it can be secured practically as a gift. The purpose is to incorporate for $100,000. Fifty thousand dollars in stock of this to go to pay for the plant and $50,000 for the working capital, to be divided up in $100 shares. This $50,000 would be sufficient to place the plant on a practical paying basis, and every stockholder would have the right to send as many boys to this school as he might see fit up to the capacity of the plant and in regular succession. They would also have the right to have these apprentices educated on their patterns. The writer will agree to market and take care of the output of the castings of this plant without in any way entering into competition with the stockholders who may be operating jobbing foundries. Should anyone prefer to make a donation toward this purpose instead of a stock subscription, he would be allowed the same privilege as a stockholder as far as sending apprentices to the school is concerned. Should this proposition meet with your approval, I may say I have the stock subscription to which I have quite a number of shares already subscribed. Stock to be paid for, 25 per cent. cash and balance in 60 and 90 days.

New Publications.

"Practical Perspective." By Frank Richards and Fred H. Colvin. 56 5½x8-inch pages with 62 illustrations. The Derry-Collard Company, New York, Price, 50 cents.

By practical perspective the authors of this pamphlet mean isometric projection. The first part of the book, by Mr. Richards, is a very clear and simple explanation of the method of making isometric drawings, and the second part, by Mr. Colvin, is an equally simple explanation of the method of using the Derry-Collard Company's isometric paper, of which we have already given a favorable notice. There is no doubt whatever that isometric drawings could be advantageously used to a much greater extent than they are, and there is just as little doubt that this isometric paper overcomes about all of the few difficulties that are supposed to stand in the way of an increased use of such drawings. If any reader has any doubts of the greater clearness of isometric as compared with ordinary drawings in many cases, his doubts will be removed by the illustrations given. The pamphlet should have an appreciable effect in increasing the use of this system of drawings, and especially in increasing the use of isometric paper.

New Tools and Machine Shop Appliances.

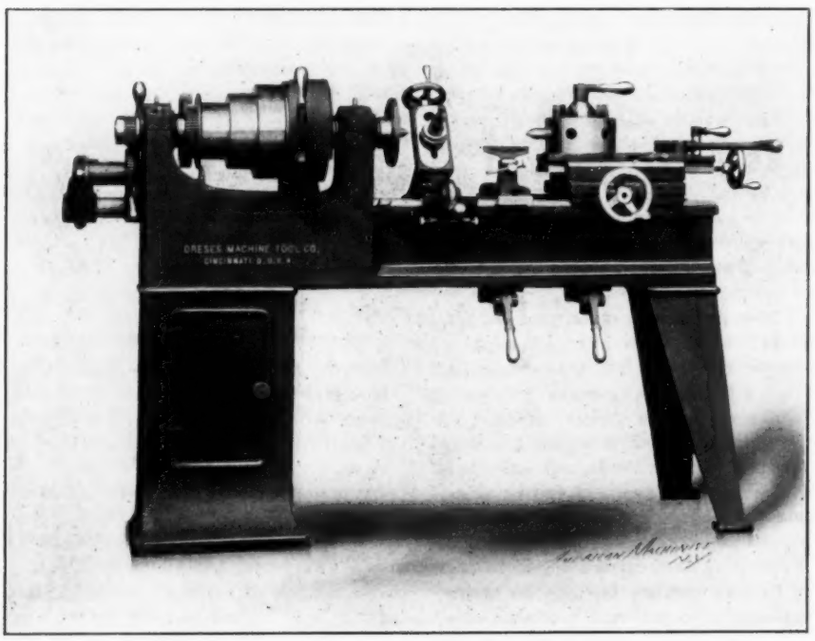
NEW FRICTION BACK-GEARED UNIVERSAL TURRET LATHE.

The half-tone shows a new 13-inch friction back-geared universal turret lathe, adapted for brass and general work. The demands of modern practice have been kept in view in the design, and the driving power and important dimensions have been decidedly increased.

The bed has heavy vees, providing the means for easily setting the slides and clamping them quickly. It is supported on the three-point principle, the rear leg being hinged and fixed to the bed by tightening a single nut. There is a long opening in the top for the chips to fall through. The headstock is cast solid with the bed, and the housings are provided for either phosphor-bronze or babbitt-metal bearings.

The friction-clutch back gear is simple and positive. It enables the operator to use two speeds without stopping the machine to throw in the back gears, thus instantly changing from boring to tapping, or for turning different diameters on the same piece. The wear is taken up by a screwdriver from the outside.

The spindle, which has a 1⅝-inch hole through it, is made of special hammered crucible steel. The turret is bored for six tools, and rotates on a ground-steel stem, with a special device for taking up the wear. The index ring is of hardened steel, nearly the diameter of the turret, with ground notches for the hardened and ground square locking key. The wear in the key-seat is taken up by a taper gib and differential screw. The turret lock is withdrawn by the return stroke of the top slide, which is equal to a full automatic arrangement but less complicated and expensive. The turret slide, which has both screw and lever feed, moves in a square bearing, with a taper gib the full length of the slide for taking up the wear. The swivel slides are graduated and provided with a firm, accessible clamping device. There is also a screw cross-feed with a graduated collar.



FRICTION BACK-GEARED UNIVERSAL TURRET LATHE.

The chasing bar is very rigid and slides in three substantial bearings. Right- and left-hand, straight and taper threads are cut with the same leader and follower. The taper attachment is adjustable and graduated. The follower arm is of new design and is so arranged that it does not withdraw from the leader while cutting taper threads. Leaders and followers for cutting 11½, 14 and 18 threads and a double friction countershaft are included in the outfit. The machine is built by the Dreses Machine Tool Company, Cincinnati.

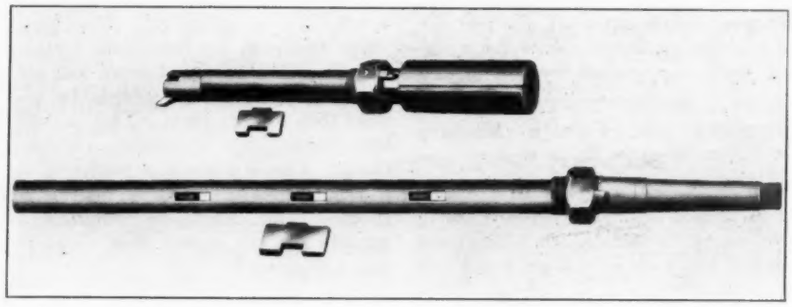


FIG. 1. HOLLOW BORING-BARS.

HOLLOW BORING-BARS.

These boring-bars are made from cold-drawn steel tubing of ample thickness, the outside tube not only driving the cutter, but also centering it when the cutter is double-ended, the centering boss, which fits the inside of the bar, being on the side opposite the cutting edge, to permit sharpening. It will be seen from the line cut that the draw-bolt, shown in the long bar, fits the inside of the bar throughout its entire length, thereby making it possible for such bars to have any number of slots to receive cutters in positions most convenient for the work. The cutters are held by the nut and key shown near the shank of the bar. The key fits snugly in the draw-bolt, but passes freely through the slot in the bar. These slots are of sufficient length to allow for adjustment to different sizes of cutters, so that square self-hardening steel may be used as well as flat cutters of twice the width. The key is squared up on the edge, where the nut engages it, and a small shoulder is formed which fits a recess of the nut, preventing the key from working out of position. This end of the bar receives the taper shank, which is screwed into place. The bar is turned true its entire length, so that it can be carried in a guide bushing in an outer support. When the bars are constructed for use in vertical boring mills and lathes, they are furnished with a slot to

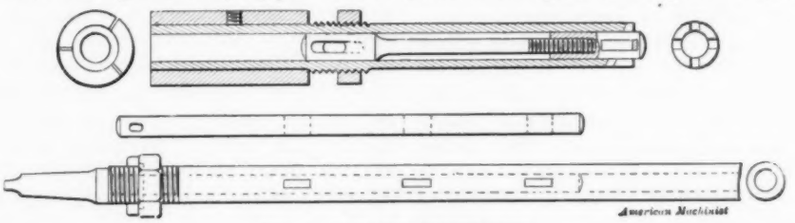
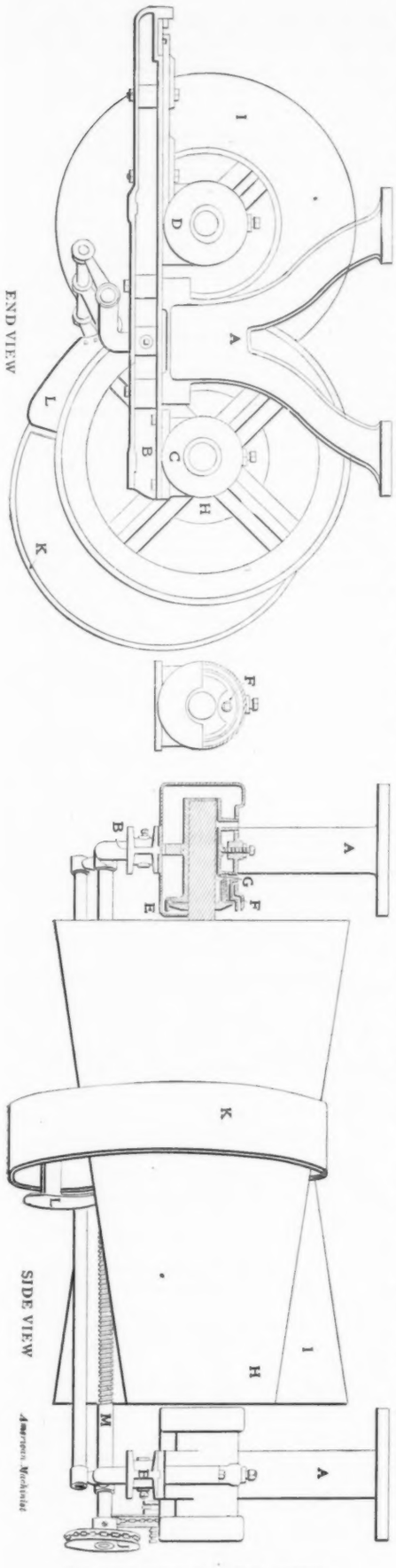


FIG. 2. HOLLOW BORING-BARS.



VARIABLE-SPEED FRICTION CONES.

receive a cutter of the same kind shown in the extreme end of the short bar in the half-tone, the edge of the cutter being ahead of the end of the bar, and in addition to the square slot the bar has a slot cut at 45 degrees to allow the tool to be set at an angle suitable for facing the bottom holes, etc. It will be seen from the drawing that in this instance the body of the draw-bolt is turned down at one end and threaded to receive a slotted head, which makes it possible to tighten the cutters in either the square or the angular slot; it also allows for adjustment for different sizes of steel. The bars of this type are made with straight shanks of sufficient length to be held directly in the machine either with or without a sleeve. The bars are made in any length and diameter to suit different classes of work, by the Grant-Nelson Tool Company, 695 West Lake street, Chicago.

FRICTION CONES.

The friction cones shown in the line-cut have lately been improved, so that the cones are interchangeable, and those having other diameters and ratios of speed than those ordered with the device may be substituted if the occasion arises for doing so. The device can also be used as a floor stand. Although this variable-speed appliance is widely known, it would be perhaps as well to briefly describe its operation. Mounted on one end of the shaft of one of the cones—for instance *I*—is the driving pulley, which receives its motion through a belt from the line shaft. On the end of the shaft of *H* would then be the driven pulley. Between the faces of these two cones is interposed the endless friction belt *K*. The position of *K* is controlled by the guide *L*. The guide *L* is moved to the desired position and held there by a nut attached to it and working on the screw *M*, on the end of which is the chain wheel *J*. When the operator pulls the endless chain on *J*, so as to move the belt *K* to the largest diameter of *I*, then *I* will drive *H* at its smallest diameter through the belt *K* and consequently the speed of the driven pulley will be high. On the other hand, if *K* be at the smallest diameter of *I*, and the largest diameter of *H*, the speed of the driven pulley on the shaft with *H* will be low.

The hanger *A* has a slot in it which corresponds with a tongue running lengthwise on the beam *B*. Two caps-screws secure the beam *B* to the hanger *A*. The opposite side of the beam *B* may be secured to the hanger *A* and the device used as a floor stand, in which position the motion of the friction belt is from below, up between the rollers, thus making it impossible for anything falling upon the rollers to be drawn into them. The box *C*—called the "head" box—is fixed. The holes in it—for cap-screws which secure it to the beam *B*—are drilled off center, as may be seen in the end view of the device. This permits a certain alteration of its position on the beam *B*, depending on the amount that these holes are off center. The sliding box *D* is so secured to the beam *B* that it can be adjusted to or from the head box *C*. By altering the center distances of *D* and *C* larger or smaller cones may be inserted. The self-oiling box is shown in section and end view. The thrust collar *E* picks up the oil and carries it to the square sliding plug *F*, which diverts it back to the pocket *G*; from there it passes throug h the oil grove in the top, and is distributed on the journal. The manufacturers of this device are the Evans Friction Cone Company, Newton Center, Mass.

A Machine for Bending Angle Iron.

This machine possesses several novel features for bending angle iron for all sorts of structural work. The bending is done cold, by means of rollers which draw the work through the machine and at the same time bend it.

Anyone who has attempted to bend angle iron by hand knows what a difficult job it is to keep the work from bending

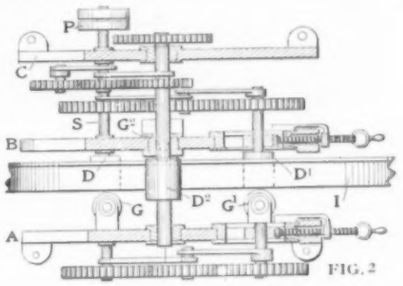


FIG. 2

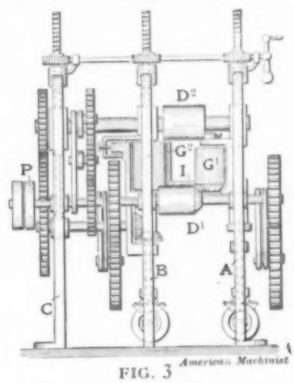


FIG. 3

DETAIL OF THE MECHANISM.

two ways at once. This objectionable feature in angle iron gives no trouble when using this machine, as vertical guide rollers overcome any tendency of the iron to bend or kink sideways.

Fig. 1 shows a view of the machine with an angle iron in process of being bent, and a number of pieces bent to various curves lying on the floor.

By referring to Figs. 2, 3, and 4 the general construction of the machine can be easily grasped. The frame-work of the machine consists of three standards, *A*, *B* and *C*. At Fig. 4 the bending rolls

D, *D1* and *D2* may be seen. The roller *D* is mounted on the same shaft as the driving pulley *P*, and is not adjustable. The bending rolls *D1* and *D2* are adjustable, so that curves of any radius may be bent. The rolls *D1* and *D2* are driven from the shaft *S* through trains of gears.

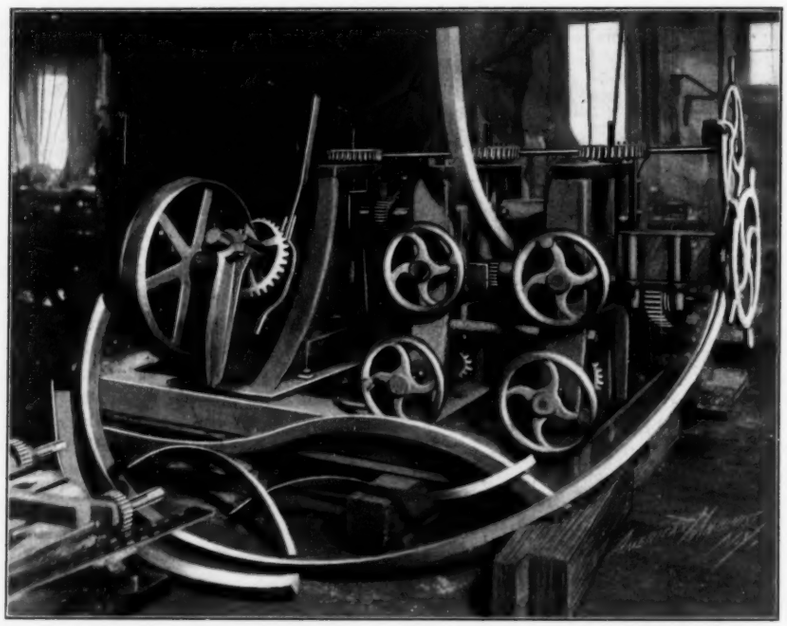


FIG. 1. ANGLE-IRON BENDING MACHINE.

These trains of gears are flexible, so as to permit the adjustment of the rolls *D1* and *D2* before referred to.

Beside the bending rolls there are three guide rolls *G*, *G1* and *G2*. These guide rolls are adjustable laterally. Their object is to keep the angle iron straight, laterally, during its passage through the machine, and thus insure its remaining so

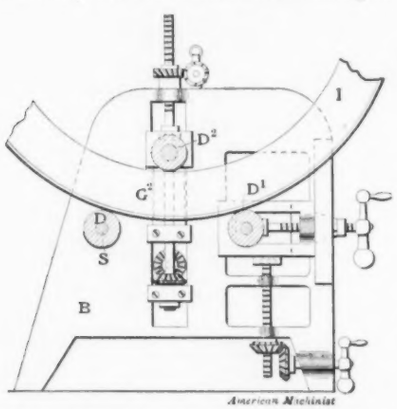


FIG. 4. VERTICAL AND HORIZONTAL ADJUSTMENT OF THE ROLLS.

when finished. The guide rolls and bending rolls are driven in unison. Motion is transmitted to them through miter gears; thus, *D* drives *G*, *D1* drives *G2*, but *G2* is driven through spur and miter-gear train from the shaft *S*. Vertical adjustment of the bending roll *D2* is through worm gears mounted on the tops of the housings *A*, *B* and *C*, connecting to the roller-shaft boxes through nuts and screws. At Fig. 4 may be seen the vertical and horizontal adjustments—by cranks and screws—for the bending roll *D1* and the guiding roll *G1*. *I* is the angle iron passing through the machine. This machine was invented by Geo. L. Vogel and Anthony Finck, 875 Montgomery street, Jersey City, N. J.

In discussing suction gas producers recently, Mr. Dugald Clerk is reported as having said that up to certain powers it was proving a very dangerous competitor of coal gas. Being able to start even a 40 horse-power engine within a very few minutes, and not needing to give the producer much attention, there was considerable advantage. In one test he had made he found that the engine was receiving 86 to 89 per cent. of all the heat contained in the coal.—*The Gas Engine.*

Personal.

J. G. Lepper, formerly superintendent of the Automatic Hook & Eye Company, of Hoboken, N. J., has, together with two other engineers, opened an office at 136 Liberty street, New York, under the firm name of Gardner Engineering Company.

Ulrich Peters has resigned his position as checker of drawings in the drafting room of the National Tube Company, Frick Building, Pittsburg, Pa., an dwill take another position. He has held the position named during the past two and a half years.

Obituary.

E. C. Haines, proprietor of the Woodstown (N. J.) Machine Works, was found dead in his bed July 27. Mr. Haines was of an inventive turn and had various patents. He had lately applied himself closely to designing and building an automobile. He was sixty-four years old.

Business Item.

The E. G. Smith Company, Columbia, Pa., has recently been organized, and will carry a line of calipers, levels and other instruments of accuracy.

The Ingersoll-Rand Company took possession of its new offices on the fourteenth floor of the Bowling Green Building, 11 Broadway, New York, on August 1. At that time the offices of the Ingersoll-Sergeant Drill Company, at 26 Cortlandt street, and the Rand Drill Company, at 128 Broadway, were given up, and the united forces moved to the new offices.

A company has been organized in the village of Lowville, N. Y., to be known as the Fulton Machine & Vise Company, for the purpose of taking over the plant formerly known as the Wetmore Iron Works, of that village, and articles of incorporation were recently filed with the Secretary of State. The company is composed of a number of representative men of Lowville and Watertown, N. Y. The former business of this plant will be continued, and a line of vises known as the Fulton patent vise will be built, together with a general line of the plain vises, such as are already on the market. E. W. Fulton and T. S. Dibble, of Watertown, N. Y., are the practical men that will have the active management of the business. These men have been with the Bagley & Sewall Company, of that place, for several years, and have both had a large range of experience on general work. The new vises introduced by Mr. Fulton are covered by a United States patent issued May 5, 1903, and a Canadian patent issued November following, of the same year.

Manufacturers.

The Lakeport (N. H.) Lumber Company is erecting a new plant.

The Skinner Chuck Company, New Britain, Conn., will enlarge its plant.

The Fitzgerald (Ga.) Cotton Mills will spend $100,000 in improvements.

The International Watch Company, Jersey City, N. J., will erect a new factory.

Winn Bros., Washington Court House, O., will erect a flouring mill in Columbus.

A $12,000 boiler shop will be erected for Thos. C. Basshor & Co., Baltimore, Md.

The American Stove Company, Cleveland, O., will erect a new factory in Lorain, O.

The Memphis (Tenn.) Queensware Company will erect an addition, to cost $10,000.

The Modern Frog & Crossing Company, Chicago, Ill., will erect a plant, to cost $250,000.

The Southern Engine & Boiler Company, Jackson, Tenn., will establish a plant in Memphis.

The C. A. Burton Machine Company, Kansas City, Mo., has let contract for a $30,000 factory.

Parlin, Orendorff & Martin, Omaha, Neb., will erect a new warehouse, costing about $100,000.

A $43,000 addition will be built to the straw hat factory of M. S. Levy & Sons, Baltimore, Md.

The Providence (R. I.) Telephone Company will erect a new telephone station in Warren, R. I.

The Logan Construction Company, Chillicothe, O., will build an addition to its automobile plant.

The machine shops of the Alabama School for the Deaf, Talladega, Ala., were burned; loss, about $25,000.

The French & Heald furniture factory, at Milford, N. H., will be enlarged by an addition of four stories.

The New England Telephone & Telegraph Company, Boston, Mass., will erect a building in Waltham, Mass.

The plant of the Austell (Ga.) Improvement Company, manufacturing lawn swings, etc., was burned; loss, $10,000.

The United States Leather Company, Chicago, Ill., has had plans prepared for a new warehouse, to cost about $100,000.

The Peters Pork Packing Company, McKeesport, Pa., will increase the capacity of its plant, expending about $24,000.

The Bangor Silk Company, of Bangor, Pa., is being formed by H. E. Graffin, W. R. Thomas, Jr., of Catasauqua, and others.

S. W. Straus & Co. will build a four story and basement warehouse at 1609 and 1611 Prairie avenue, Chicago, to cost $50,000.

The machine shop of the Charleston Machine & Manufacturing Company, Bethlehem, Pa., was totally destroyed by fire recently.

The H. H. Franklin Manufacturing Company, Syracuse, N. Y., has bought land for the purpose of enlarging the present factory.

Plans are being perfected by the Columbia Chemical Company, Barberton, Ohio, for the construction of a large addition to its plant.

The Ericsson Electrical Supply Company, of Chicago, Ill., is erecting a plant in Tonawanda, N. Y., which will employ 1,500 hands.

The Ohio Brass Company, Mansfield, O., has had plans prepared for a new plant, to take the place of the one burned some time ago.

The Chattanooga (Tenn.) Boiler & Tank Company is being incorporated; capital, $25,000. S. H. Daniels, F. P. Jenkins, etc., incorporators.

The Excelsior Needle Company, Torrington, Conn., will enlarge its plant by the addition of two buildings. One, of brick, is to be 55x102 feet.

The Rockford (Ill.) Match Company has been organized, and will soon rebuild the old Graham factory, which was recently destroyed by fire.

Fire recently destroyed the Allard Iron Works at Sandy Hill, one of the oldest manufacturing plants in northern New York. The loss was $5,000.

The Pilling Air Engine Company, Detroit, Mich., has increased its capital stock and will erect a new plant. Charles L. Grimes is manager of the company.

The American Shovel & Stamping Company, Lorain, O., proposes erecting a rolling mill and stamp works at Middletown, O. R. T. J. Martin is interested.

Frederick H. Lewis, of Staunton, Va., and J. Ross Hanahan, of Birmingham, Ala., are interested in the proposed erection of a $400,000 cement plant in the latter city.

Henderson & Co., Philadelphia, Pa., are estimating on a building for cleaning flues, as an addition to the repair shops of the Philadelphia & Reading Railway at Reading.

The C. H. Besly Company will soon begin the erection of a fireproof brick and cement factory at Beloit, Wis. The new building is to be 175 feet in length and two stories high.

The General Electric Company's plant at Lynn, Mass., is to be enlarged by the addition of new buildings which will accommodate 2,500 hands. Work is to begin immediately.

Henry Stark will erect a new boiler and machine shop at Joplin, Mo. The new building will be a large, two-story brick structure, and will be fitted up with the most modern machinery.

The New York, New Haven & Hartford Railroad is preparing to erect large repair shops at Norwood, Conn. It is expected the shops will be completed early in the autumn of next year.

Preparations are being made by the Vernon Lead & Zinc Company, of Joplin, for the erection of a 135-ton mill at Webb City, Mo. The plant is to be equipped with the latest improvements.

The Chattanooga (Tenn.) Boiler & Tank Company has been incorporated, with a capital of $25,000. The new plant will be located on Tenth street. Frank Jenkins is the superintendent.

The Standard Roller & Ball Bearing Company, at Forty-eighth street and Girard avenue, Philadelphia, Pa., is building a large addition to its plant. It will be placed in operation on August 1.

The Van Dorn Iron Works Company, Cleveland, O., is erecting a large factory building at its works on East Madison avenue. This will be 120x280 feet in size, and will be of brick and steel construction.

The contract has been awarded to the B. H. Hibbard Company, of New Britain, Conn., for a new office building to be erected by the Whitlock Coil Pipe Company, of Hartford, Conn. The new building is to be one story high, of brick, 50x106 feet.

The American Can Company, of New York, will erect in New Orleans a modern plant to cost not less than $300,000, and which will give employment to 300 operatives. W. S. Dirkes is the American Can Company's representative in New Orleans.

Wm. Steele & Sons, Sixteenth and Arch streets, Philadelphia, Pa., have the contract for an addition to a mill, at Second and Allegheny avenues, for Thomas Boggs & Son. Brick, six stories, slag roof; power equipment and special machinery.

W. E. A. Wheeler and W. G. Whitehead have bought the Wisconsin Attachable Ball-Bearing Hub Company, and are looking for a site on which to build a factory. The company is capitalized at $35,000. The office is at 414 Cedar street, Milwaukee, Wis.

The Fenn Bros. Company, of Leavenworth, Kan., manufacturer of hardwood flooring, has purchased six acres of land on Railroad avenue, west of the Horn Lake road, in South Memphis, Tenn., upon which it will erect a plant and begin operations by January 1.

A concession has been granted to a Pittsburg syndicate, of which H. P. Dilworth is the head, to use the water flowing over the Springdale dam in the Allegheny River for power purposes. As a result an electric power plant, to cost $400,000, will be built.

Fire recently caused $100,000 damage in the factory of the Ireland & Mathews Manufacturing Company, at the corner of Wight street and Mount Elliott avenue, Detroit, Mich. Loss is covered by insurance. Ireland & Mathews manufacture plumbers' supplies.

Larned, Carter & Co., overall manufacturers, 245 Abbott street, Detroit, Mich., have just given Varney & Co., architects, instructions to build an addition to their factory, which will give them more room to employ several hundred more girls in their rapidly increasing business.

United Shoe Machinery Company of Canada is adding to the capacity of its Montreal works by the erection of a five-story building, 35x85 feet. The company contemplates further extensions, and has plans for a power plant to furnish electric light and power for the completed works.

The Hart & Hegeman Manufacturing Company has commenced work on its new factory at the northwest corner of Capitol avenue and Broad street, Hartford, Conn. The building will be 60x190, three stories high, and be built of red-faced brick. Red Longmeadow sandstone will be used in the trimmings.

Ballinger & Perrot, Philadelphia, Pa., architects and engineers, are preparing plans and specifications for a manufacturing plant, consisting of a machine shop, foundry, pattern and pattern-storage shop and boiler-house, to be erected at Elkins, W. Va., for the Humphrey Manufacturing Company, of Towanda, Pa.

The contract has been closed with the Tide Water Building Company, of New York city, for the construction of the large addition to the Underwood Typewriter Company's plant on Capitol avenue, Hartford, Conn. The capacity of the plant will be doubled by the erection of two brick buildings, 50x400 feet and 50x150 feet, each five stories high. Several smaller buildings will also be required.

New Catalogues.

Ernst G. Smith, Columbia, Pa. Circulars illustrating and describing calipers, gages and levels.

Scully Steel & Iron Company, Chicago, Ill. July and August stock list. Illustrated. 4½x7, pp. 144, paper.

Gisholt Machine Company, Madison, Wis. Bulletin illustrating the 41½-inch Gisholt lathe. 9½x7½. Illustrated.

American Blower Company, Detroit, Mich. Catalogue No. 180, describing "A, B, C" exhaust fans. Illustrated. 7x9, pp. 66, paper.

Murray Machinery Company, Kansas City, Mo. Circulars descriptive of routers and shavers for engraving and printing shops. Illustrated.

The Duff Manufacturing Company, Pittsburg, Pa. Catalogue "F," descriptive of various types of "Barrett" jacks. 6x9, pp. 72. Illustrated.

The Cutter-Hammer Manufacturing Company, Milwaukee, Wis. Bulletins No. 59, 67, 68½ and 78, descriptive of various types of electrical controllers.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 56-57, supplementary to No. 55, descriptive of generating sets with "Case" and "Forbes" engines.

The Schwerdtle Stamp Company, Inc., 39-41 Cannon street, Bridgeport, Conn. Catalogue describing steel and rubber stamps. Illustrated. 3½x6, pp. 10, paper.

Crandall Packing Company, Palmyra, N. Y. Catalogue and price-list of improved steam, ammonia and hydraulic packings. Illustrated. 5x7½, pp. 73, paper.

Wyman & Gordon, Cleveland, Ohio, and Worcester, Mass. "A Short Story of Nathan Read," one of a series of short stories of engineers, published in place of a catalog.

Link-Belt Engineering Company, Philadelphia, Pa. Catalogue of the "Renold" roller chain. This contains price-list and very fine half-tone illustrations. 6x9, pp. 12, paper.

Kisinger-Ison Company, 466-472 Pioneer street, Cincinnati, O. Catalogue "B," describing the Sterling friction clutch. Table and price-list. Illustrated. 3½x6, pp. 24, paper.

The Carlyle-Johnson Machine Company, Hartford, Conn. Catalogue "C," descriptive of the Johnson friction clutches and of some of their new features. 3½x6½, pp. 20. Illustrated.

Williamson Bros. Company, Philadelphia, Pa. "A Condensed Talk on Condensers." A handsomely printed and illustrated booklet containing much information regarding condensers.

J. G. White & Co., New York. Booklet of "Canadian White Company, Limited," descriptive of policy of the company and résumé of some of its engineering and construction contracts.

The Toledo Pipe Threading Machine Company, Toledo, Ohio. Pamphlet descriptive of the various types of pipe-threading devices manufactured by this company. 3x6, pp. 9. Illustrated.

Hyatt Roller Bearing Company, Harrison, N. J. Bulletin 126, descriptive of the first rolling road of its kind in the world, now in operation in Cleveland, O. Illustrated. 9¼x6¾, pp. 8, paper.

Baldwin Locomotive Works, Philadelphia, Pa. "Record of Recent Construction, No. 50." Handsomely printed and illustrated pamphlet describing recent developments in electric motor trucks.

Warren Webster & Co., Camden, N. J. Pamphlet describing the Webster specialties, for use in connection with the company's system of steam circulation for heating purposes. Illustrated. 4x9, paper.

Ingersoll-Sergeant Drill Company (Pneumatic Tool Department), 26 Cortlandt street, New York. Catalogue, Form No. 6, describing Haeseler "Axial Valve" hammers. Illustrated. 6x9, pp. 19, paper.

De Laval Steam Turbine Company, Trenton, N. J. Bulletin No. 10, describing the works and product of this company and containing a sketch of the inventor, Dr. De Laval. Illustrated. 6x9, pp. 57, paper.

The Hendey Machine Company, Torrington, Conn. Catalogue describing milling machines with various attachments and of various types. A handsomely printed catalogue, with fine engravings on heavy wood-cut paper. 6x9.

Schutte & Koerting Company, Philadelphia, Pa., 47 Dey street, New York. Circulars illustrating and describing noiseless and automatic stop-check valves, quick-closing balanced trip valve and combined throttle and quick-closing trip valve.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 53 (superseding No. 43) on direct-current lighting and power generators. Illustrated. 7½x10, pp. 16, paper. Bulletin No. 55, illustrating and describing small generators arranged for direct connection. 7½x10, pp. 4, paper.

Mason Regulator Company, 158 Summer street, Boston, Mass. 1905 catalogue describing the various styles of reducing valves made by this company, together with full information for the successful operation of them, and illustrated by very fine half-tone engravings. 6x9, pp. 55, paper.

Diamond Saw & Stamping Works, Buffalo, N. Y. Catalogue illustrating and describing "Sterling" hacksaw blades and frames. 4½x6, pp. 8, paper. Also pocket memorandum book, which has a pretty celluloid cover and contains some useful data, such as metric equivalents, rates of postage, etc.

American Steam Pump Company, Battle Creek, Mich. Catalogue describing belt-driven pumps and air compressors. Illustrated. 3½x6, pp. 10, coated paper. Also catalogue describing Marsh steam pumps of various types, and handsomely printed on heavy coated paper. 6½x7¾, pp. 30.

Oswego Machine Works, Oswego, N. Y. Catalogue describing the Brown & Carver and Oswego power cutting machines, automatic clamp and hand clamp, for paper mills, printers, boxmakers, etc. Illustrated. 7x9, pp. 24, paper. Also catalogue of hand lever cutters, bench cutters, hand-wheel drive cutters, die-cutting presses. Illustrated. 7x9, pp. 16, paper.

"Interurban Railway Construction" is the title of an artistic bulletin just issued by J. G. White & Co., Inc. The bulletin is illustrated with several interesting half-tone reproductions of various phases of interurban railway work, as executed by the White Company. A copy will be sent to anyone writing for same to the home office, J. G. White & Co., 43 Exchange Place, New York.

Montgomery & Co., 105-107 Fulton street, New York. Catalogue No. 22. This is a very comprehensive catalogue of machinists' tools, machinery and supplies and containing numerous illustrations. It will be sent to anyone on receipt of $1; this to be refunded with the first purchase amounting to $10 or over. In this way a customer will get the book for nothing, otherwise a valuable book of information for a nominal sum. 4½x6½, pp. 928, cloth.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—One second-hand geared shaper, not less than 24 in. stroke. Box 425, AM. M.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Air compressor with 8 or 10 in. duplex steam and compound air cylinders. Box 372, AMERICAN MACHINIST.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Consulting Engineer desires to receive catalogues from manufacturers of steam, electric and power machinery and specialties. E. L. Cridge, Room 503, 123 Liberty st., New York.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

A man familiar with method of casting threads in cast iron, and at present superintendent of foundry and machine shop, desires to interest manufacturer in cast threads and introduce the method of casting same. Threads cast where they cannot be cut. Castings complete when shaken from flask. Box 450, AMERICAN MACHINIST.

For Sale.

One 125-lb. belt-driven Lingle power hammer; hammer in perfect condition; absolutely good as new machine; St. Louis delivery, 30 days. Box 397, AMERICAN MACHINIST.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

For Sale—An up-to-date manufacturing shop, located in Manhattan, New York city, suitable for inventor, general machine, experimental work or manufacturing; first-class machinery; electric power; large assortment fine tools; foreign and domestic trade; patents, stock, good will, or plant alone; reasonable. Address Box 442, AMER. MACHINIST.

Business Opportunities.

Machinists who can take financial interest in shop write to Box 446, AMER. MACH.

Wanted—Vigorous, practical mechanic, with good business sense, to invest from $1,000 to $3,000 and take management of established, well-equipped hardware specialty and light drop forging business in thriving western New York town; splendid opportunity for reliable, energetic man. Address P. O. Box 8, Wayland, N. Y.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

NEW JERSEY.

Expert Jones & Lamson flat turret operator desires change; take charge or operate. Box 423, AMERICAN MACHINIST.

Toolroom foreman wants position; good technical education; can make drawings; fine interchangeable work preferred. Box 432, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 452, care AMERICAN MACHINIST.

Mechanical draftsman, general machinery, wishes position; salary $18. Box 434, A. M.

Mechanical draftsman, quick detailer, neat tracer, wants position. Box 454, AM. MACH.

First-class mechanical draftsman wants to change; New York or Brooklyn. Box 417, AMERICAN MACHINIST.

Wanted.—Technical graduate wishes a position as mechanical draftsman. Address "Experience," care AMERICAN MACHINIST.

Automobile engineer, extensive experience designing commercial vehicles; open for engagement. "Electro," care AMER. MACH.

Draughtsman wishes position (4 years' machinist) to take charge of small shop, or if possible alone in some concern. Orlioff, 319 Marcy ave., Brooklyn, N. Y.

Foreman pattern-maker; practical man; quick methods in producing work; good estimator and well up in foundry practice. Address Box 448, AMERICAN MACHINIST.

Position as superintendent or manager, by young man with A1 record; good executive and business abilities; large concern preferred. Box 438, AMERICAN MACHINIST.

Designer, 30 years of age, technical graduate, at present employed, desires position as designer or assistant to master mechanic. Address Box 453, AMERICAN MACHINIST.

Mechanical engineer (34), practical toolmaker, expert designer of automatic machinery and experienced in organizing for production on modern lines, desires change. Box 411, AMERICAN MACHINIST.

Position as superintendent by a graduate mechanical engineer having extensive experience in heavy machine work, engines, pumps, water-works machinery and in shop management. Have held a position of large responsibility for several years. Address A. E. W., care AMERICAN MACHINIST.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

Strictly high-grade, brainy mechanic desires executive position, perfecting or manufacturing products. Box 441, AMER. MACH.

Mechanical engineer and expert designer, with long and varied experience, Corliss engines, power transmission, gas engines, is open for engagement; competent to take charge, and accustomed to the control of men. Box 385, AMERICAN MACHINIST.

The advertiser invites correspondence with firm needing a mechanical expert; 15 years experience designing, building and testing steam and gas engines, air-compressors and electric machinery; at present designing line of special power machinery; $1,800 lowest salary considered. Box 447, AMER. MACH.

PENNSYLVANIA.

Assistant superintendent or foreman wants position; 14 years experience in marine gasoline engines, Corliss engines, ice machines and general machine work. Best of references. Address Box 449, AMERICAN MACHINIST.

Practical engneer, with 15 years' experience designing, testing and superintendence of special machinery, desires permanent, responsible position as shop superintendent or com. engineer. Address Box 433, AMER. MACHINIST.

Capable man, practical machinist by trade and experienced in the manufacture of metal goods, well educated and of fine address, now in position requiring technical and business executive ability, would take a step upward. Box 437, AMERICAN MACHINIST.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 436, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Position wanted as shop engineer or assistant superintendent; 6 years' experience in electrical and mechanical work; technical graduate; age 28; will go anywhere. Box 435, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Machinists upon lathes and grinders. Address Bantam Anti-Friction Co., Bantam, Conn.

Wanted—Three first-class toolmakers, capable of doing small, accurate work; men experienced on a fine class of watch factory die work preferred. Apply Veeder Mfg. Co., Hartford, Conn.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MASSACHUSETTS.

Wanted—Man, 25 to 35 years of age, to supervise 10 to 15 men, distributed through various New England mills installing a new machine; previous experience in constructing and operating machinery of an unusually intricate, delicate and accurate character and in handling men is essential; in replying, give references and state age and salary expected; no applicant will be accepted without careful consideration of references and record; permanent position and good prospects for the right man. Box 443, AMERICAN MACHINIST.

MICHIGAN.

Wanted—At once, experienced foreman for modern machine shop in Michigan, building gasoline and steam engines; must be up in modern machine shop methods and capable of getting up labor-saving tools; a good opportunity for a man who can produce the maximum amount of work at a minimum cost. Box 430, AMERICAN MACHINIST.

Wanted—Experienced man to superintend sheet metal department in a large automobile factory; one who is accustomed to the latest and most modern machinery and methods; one who is familiar with automobile work preferred, such as coolers, hoods, fenders, water jackets, etc.; to the right man, attractive, permanent position; state age, salary, experience, references. Address Box 424, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—Draftsmen with experience on gas engines; state experience and pay expected. Box 427, AMERICAN MACHINIST.

Wanted—Salesman or manufacturer's agent; must be thoroughly familiar with engine packings and mill supplies; state experience, reference and salary expected. Box 402, AM. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class draftsman, erectors, boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Two or three first-class draftsmen on automatic machinery and fixtures. Address Box 444, AMERICAN MACHINIST.

Wanted—One or two first-class tool draftsmen who are accustomed to die work, jigs and fixtures; state experience and salary expected. Box 439, AMERICAN MACHINIST.

Toolmaker, experienced on screw machine tools; desirable position for competent man; to receive attention, state age, experience and salary expected. Box 429, AMER. MACH.

Several draftsmen wanted by large concern in New York city; steady employment to suitable men; state age, experience, salary and two business references. Box 419, AM. MACH.

Wanted—Experienced man in engineering department of elevator works for specifying and listing material from "Layouts" and making sketches; state age, experience and salary expected. Address Box 451, AMER. MACH.

Draftsman, experienced on jigs and fixtures for small, interchangeable work; desirable position for competent man; to receive attention, state age, experience and salary expected. "Accuracy," Box 428, AMER. MACH.

Wanted—First-class machine blacksmith; must thoroughly understand working tool steel and have some knowledge of drop forging. An energetic, progressive man can have good position. Give full particulars, wages and references. A. R. King Manufacturing Company, Kingston, N. Y.

Wanted—Expert semi-automatic turret lathe operator; one who can operate and demonstrate to customers on the road the efficiency of same; capable of devising tool equipment for the greatest production; must be up to date and a hustler; give references as to experience, ability, character and salary expected. Address "B.," care AMER. MACH.

OHIO.

Wanted—Vise and planer hands. The Niles Tool Works Co., Hamilton, Ohio.

PENNSYLVANIA.

Wanted—First-class man for running and taking care of gas engines. Apply Box 431, AMERICAN MACHINIST.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

A first-class toolmaker, accustomed to designing jigs; give experience and wages expected. Box 407, AMERICAN MACHINIST.

A working foreman for machine shop; also one for erecting floor; must be familiar with gas-engine work; state experience and salary. Box 406, AMERICAN MACHINIST.

Wanted—At once, a number of first-class machinists, experienced in machine and floor work on engines; good wages and steady employment to first-class men. Jacobson Machine Mfg. Co., Warren, Pa.

Draftsman wanted as assistant in a manufacturing plant in eastern Pennsylvania; one with some experience preferred; salary $15 per week. Address, giving age and full particulars, with references, Box 445, AM. M.

Wanted—Several good Corliss engine erectors and several fitters and floor hands; also one first-class journeyman patternmaker on Corliss engine work; highest wages to good men. Scottdale Foundry & Machine Co., Scottdale, Pa.

Lathe department foreman wanted for modern plant in Pittsburg district, building rolling mill and special machinery; good position for hustler able to get out duplicate work; state experience, age and give references. Box 405, AMERICAN MACHINIST.

Toolmaker—One able to design and build molds and punches; an intelligent man with some independence, able to tackle work which is not of the cut and dried order, can have a steady job with an opportunity for advancement in growing business. Only Philadelphia or near Philadelphia replies desired. Box 4225, Station G, Philadelphia.

RHODE ISLAND.

Wanted—Toolmakers who have had considerable experience on jig and fixture work; only first-class men need apply. Mechanical Accountant Co., Providence, R. I.

Toolmakers wanted; first-class workmen, experienced on jig and fixture work, for light high-grade machinery. Call or address, The Taft-Peirce Mfg. Co., Woonsocket, R. I.

WEST OF MISSISSIPPI.

Wanted—Foreman for machine shop located in Western town; class of work, hoisting engines. Address, with reference, "O.," care AMERICAN MACHINIST.

Wanted—Six good gas engine engineers, familiar with operating large engine plants; good salary to right men; give experience and reference. Box 426, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Mechanics to design and construct parts for automobiles; competent men can have steady positions, with prospects for advancement. Address Thomas B. Jeffery & Co., Kenosha, Wis.

Wanted—Draftsman for designing, with little instruction, parts of automobiles; good wages to the right man. Address Thomas B. Jeffrey & Co., Kenosha, Wis. (manufacturers of automobiles).

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Whitman & Barnes Mfg. Co.	96
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Whiton Mach. Co., D. E.	100
Wiley & Russell Mfg. Co.	90
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See Roller Bearings.

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Belt Filler

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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
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Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.

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Boynton & Plummer, Worcester, Mass.
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Gisholt Mach. Co., Madison, Wis.
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McCabe, J. J., New York.
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Starrett Co., L. S., Athol, Mass.

Cams

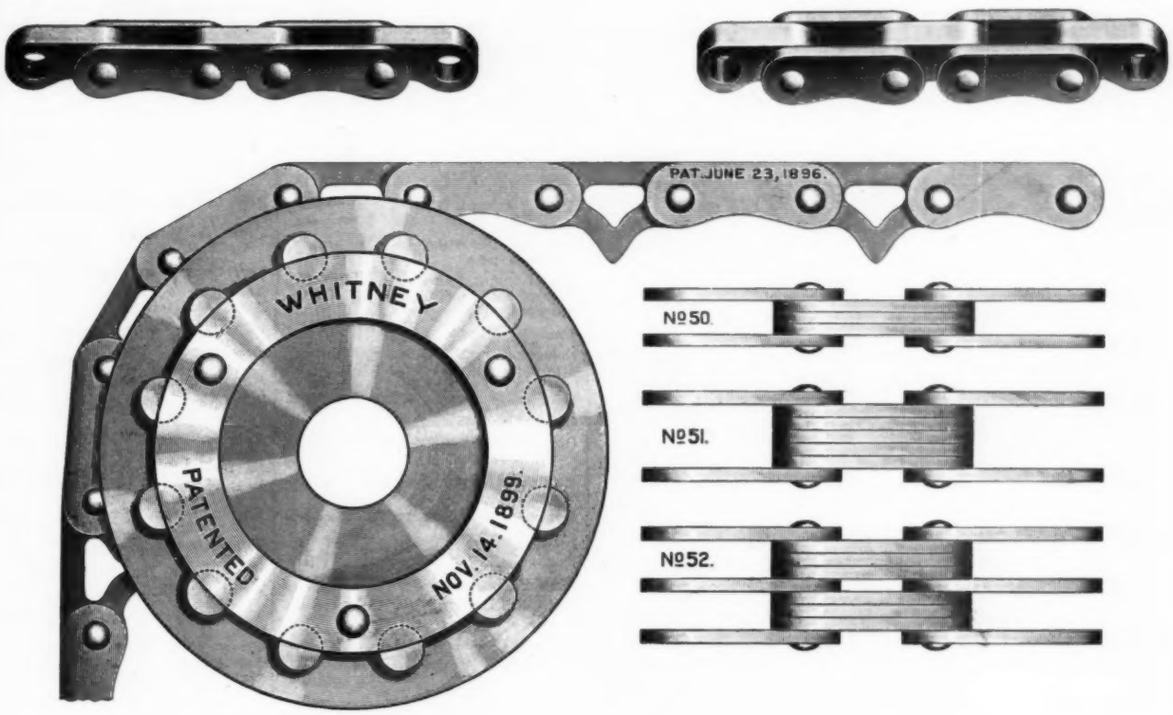
Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Brass

Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.



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Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

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Gisholt Mach. Co., Madison, Wis.
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Horton & Son Co., The E., Windsor Locks, Conn.
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Whiton Mach. Co., D. E., New London, Conn.

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Skinner Chuck Co., New Britain, Conn.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coils
Standard Welding Co., Cleve., O.

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Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
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Rand Drill Co., New York.

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Evans Friction Cone Co., Boston, Mass.

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Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

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Franklin Mfg. Co., Syracuse, N. Y.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
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Niles-Bement-Pond Co., New York.
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Cleveland Crane & Car Co., Wickliffe, O.

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Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
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Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cut Meters
Warner Instrument Co., Beloit, Wis.

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Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Brown & Sharpe Mfg. Co., Providence, R. I.
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Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

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Billings & Spencer Co., Hartford, Conn.
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Steel Set Diamond Co., New York.

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American Tube & Stamping Co., Bridgeport, Conn.
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Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
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Keuffel & Esser Co., New York.

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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo. O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Morton Machine Tool Wks., Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

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Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

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Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
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Vandyck Churchill Co., New York.

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Drilling Machines, Upright
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Hill, Clarke & Co., Boston, Mass.

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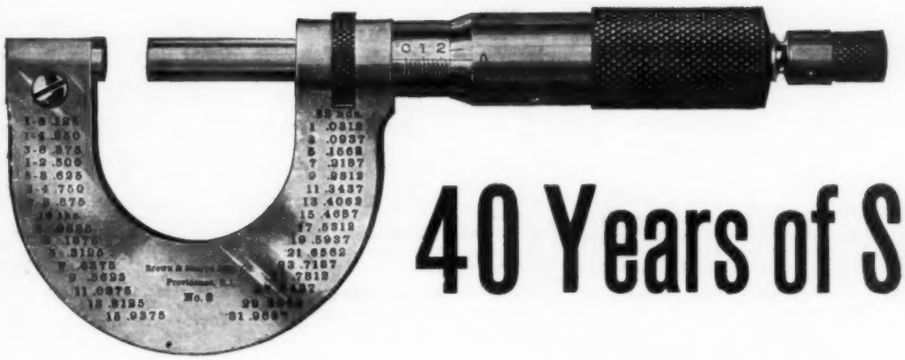

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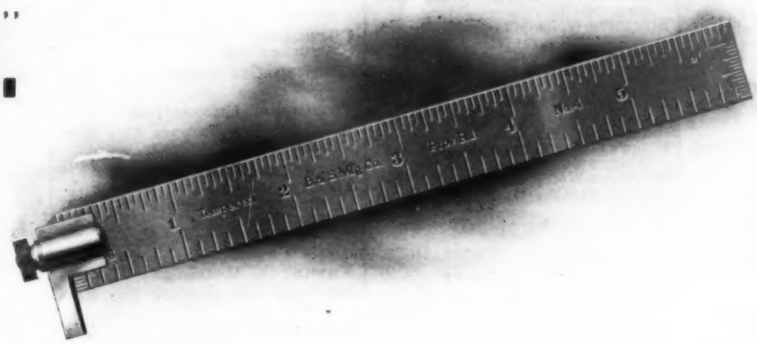

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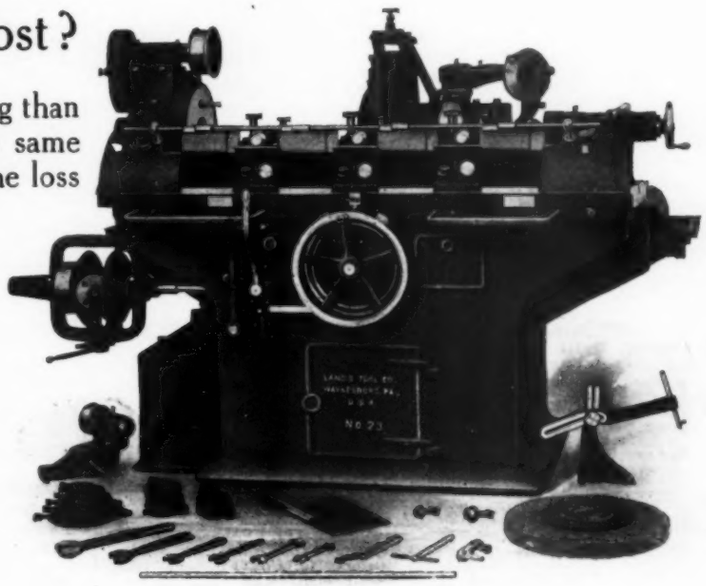

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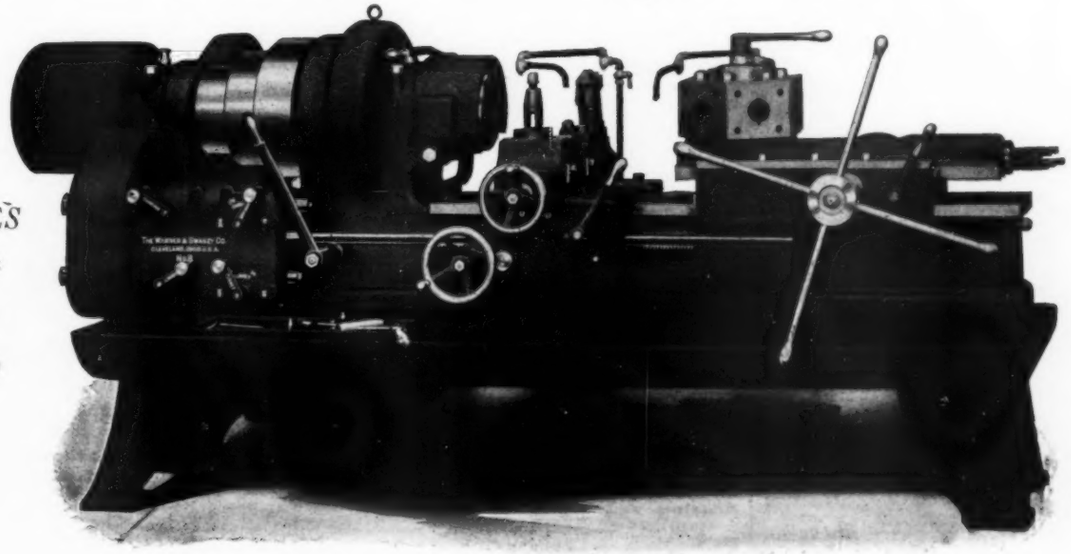

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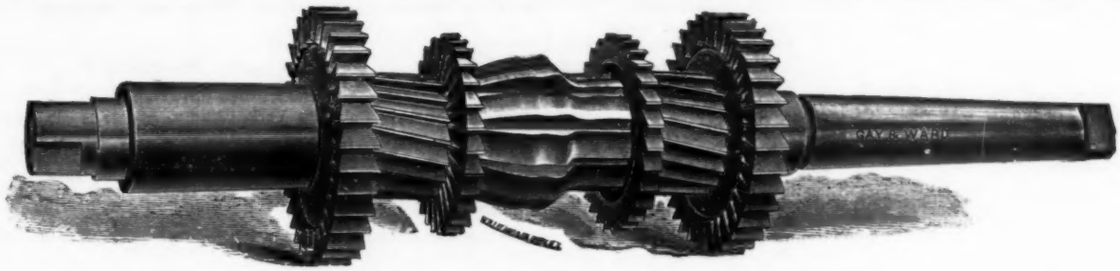

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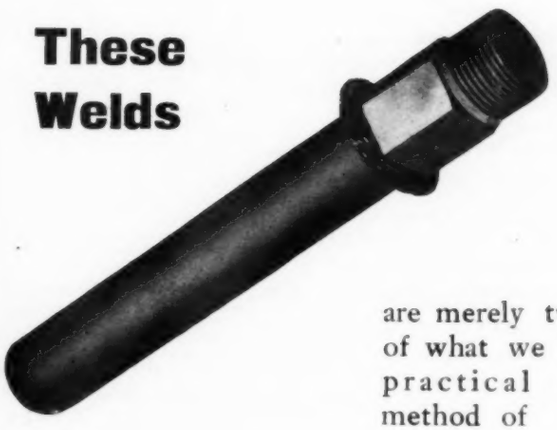

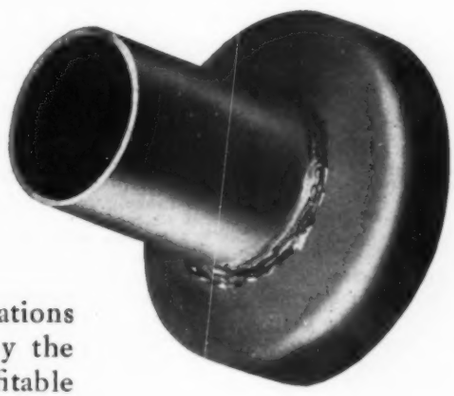

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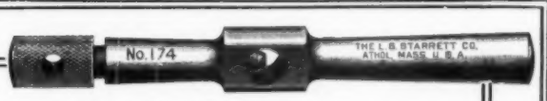

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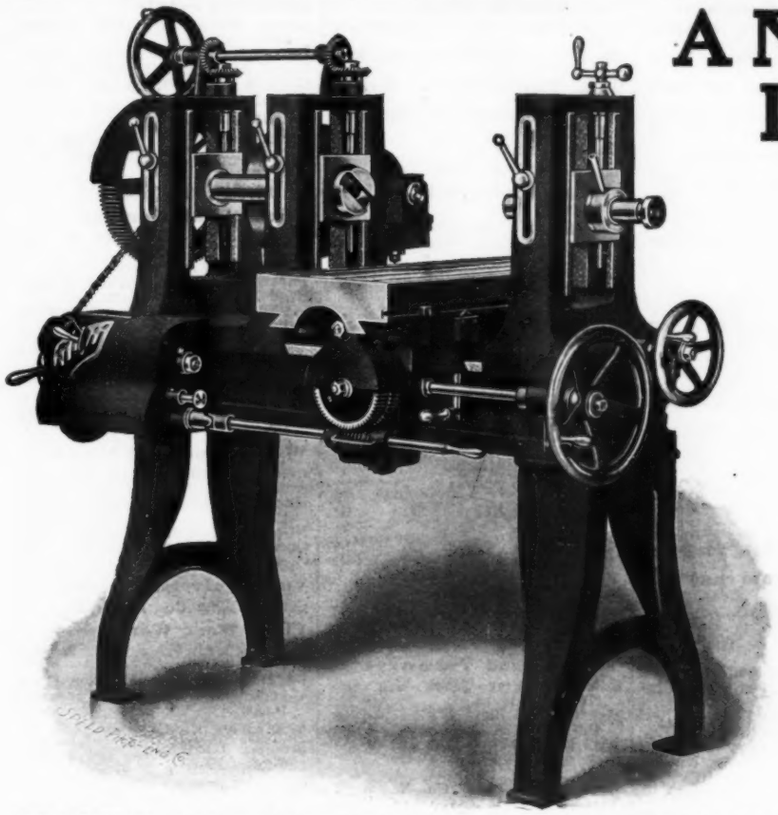

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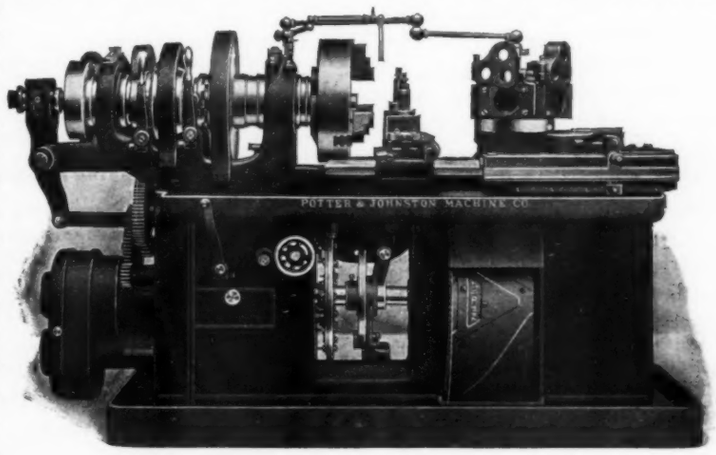

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Shop Notes from Pueblo.

EDITORIAL CORRESPONDENCE.

The works of the Colorado Fuel & Iron Company at Pueblo, Colo., is one of the finest and largest of its kind in this country, and, like so many other Western works, its products are far more varied than are those of Eastern works. Beginning with iron ore it carries this, literally raw material, to many advanced stages of manufacture.

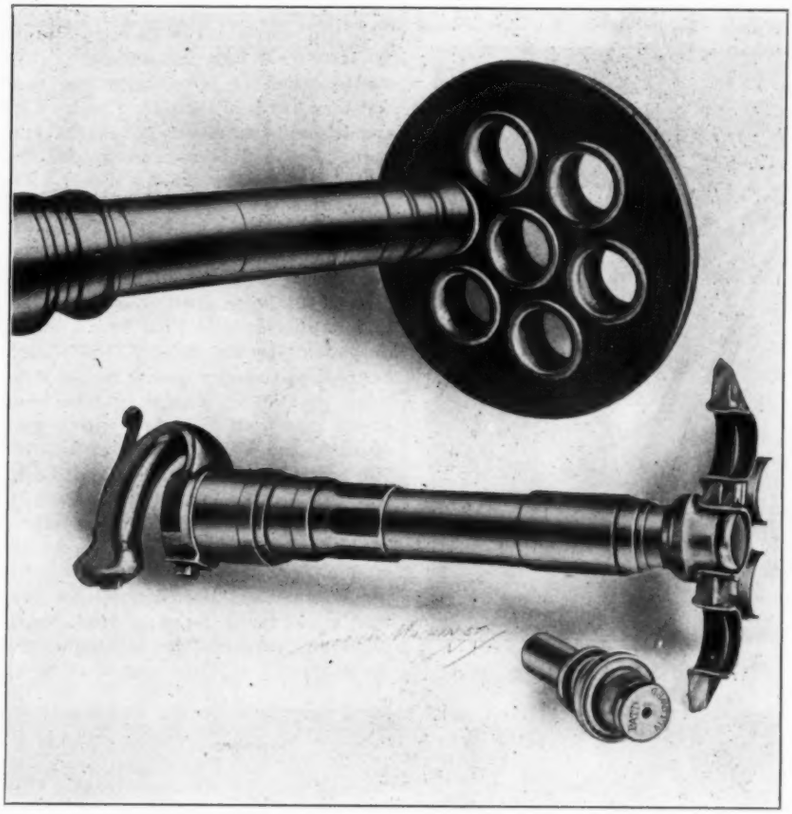


FIG. 1. A NEW BOILER-TUBE EXPANDER.

A NEW TUBE EXPANDER.

In connection with the general repairs of an iron works and steel mill, the machine shop has to do the repairs on a number of locomotives using very bad feed water, and the re-tubing of the boilers is a serious item of the work. In connection with this work, Messrs T. V. Freebury and H. A. Deuel have devised a new tube expander* which has been thoroughly tested with results that are remarkable.

If any mechanical operation would seem to have reached the stage of finality it is tube expanding. The Prosser and Dudgeon expanders do their work so well and have been standard for so many years without further improvement that one could be excused for doubting if improvement is possible, and such an entirely novel method of doing the work as this would certainly not be looked for.

*The tool is patented.

The new tool makes use of an ordinary pneumatic hammer and is as simple and incapable of getting out of order as a button set. It is shown in Fig. 1 as applied to the work and also as it appears in its working position when placed in a tube which, with its tube sheet, had been cut in half. When expanding a tube the tool is canted in the tube until its recessed flange rests on the projecting end of the tube, the head at its end bringing up against the tube bore just within the tube sheet. The hammer is then started, the handle being forced sidewise and traversed in a circle so as to carry the cramping action around the tube in a circle, three revolutions completing the work. The action is, perhaps, shown more clearly in Fig. 2, which shows how the tool simultaneously expands, prossers and beads over the tube. There is, of course, a tendency for the tool to drive the tube through the sheet, but this is prevented by driving a taper pin into the tube before the hammer is applied, thus partly expanding the tube and preventing subsequent displacement.

The action of the tool is surprisingly rapid. In one case, 144 tubes were expanded in 55 minutes, an average of 23 seconds per flue; and in another case 270 flues were expanded in 2 hours and 34 minutes, an average of 34 seconds per flue. The record performance on new work was the expanding of 65 flues in 10 minutes—an average of a trifle less than 10 seconds per flue. This quickness of operation is especially valuable when a locomotive comes in with leaky flues and it is desired to get it moving again without waiting for the boiler to cool off. Under these circumstances, 170 flues have been worked over in 15 minutes.

These figures relate to locomotive boilers of which the tubes are small. The tool must, of course, be exactly right in its proportions and dimensions, and these have not yet been worked out for the larger flues of stationary boilers, so that no figures for them are obtainable.

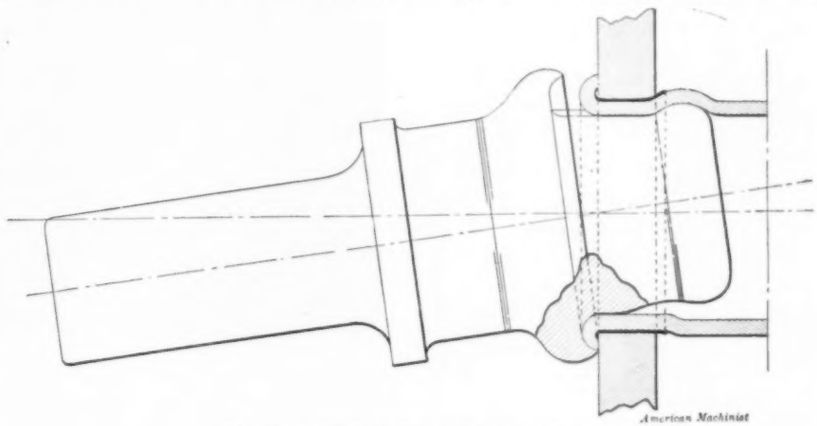


FIG. 2. ACTION OF THE TUBE EXPANDER.

AN ELLIPTICAL CHUCK.

Figs. 3, 4 and 5 show a thoroughly practical and efficient elliptical chuck which is in constant use for turning punches and boring dies for the holes in angle plates for railroad rails which must be oval in shape to permit expansion and contraction. Fig. 3 shows the chuck as set up for turning a punch, and Fig. 4 for boring a die. The construction is shown in Fig. 5. The rectangular plate *a* is screwed to the nose of the lathe spindle, and has gibbed to it the plate *b*, as shown in the plan section, to which the work chuck is bolted as shown in Figs. 3 and 4. Plate *b* may obviously slide on *a* ver-

tically in the position shown in the end view, while it cannot be displaced sidewise.

The plate *b* has bolted to it a pair of gibs on the rear of *a*, slides at *c c* at a right angle with the first pair, engaging these slides with plate *d*, which is integral with an eccentric *e*. Eccentric *e* engages a stationary eccentric strap *f*, which is bolted to the lathe headstock by slotted

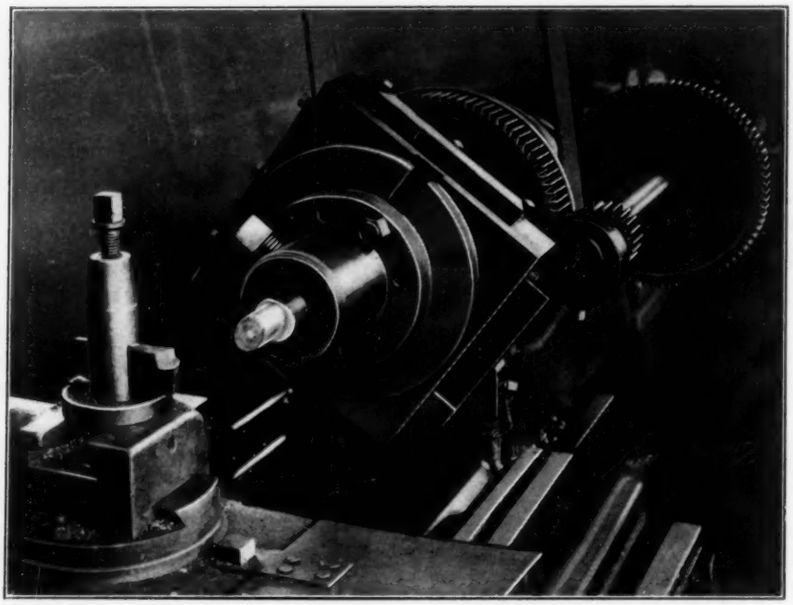


FIG. 3. ELLIPTICAL CHUCK TURNING A PUNCH.

holes and clamp studs *g*, and is adjustable horizontally by set-screws *h*.

With the eccentric strap adjusted centrally with the lathe spindle as in the illustration, the slides are inactive, but when adjusted eccentrically, plate *b* will slide on *a*, and a piece of work held by it will be turned to an elliptical form. The ecentricity is determined by the adjustment of the strap, while the diameter is determined by the adjustment of the lathe tool, the fixture being thus universal.

It is obvious that the fixture may be used on a lathe having a taper attachment, and it is in fact so used, the punches and dies being thus given their proper relief.

STRAIGHTENING BAR IRON.

Fig. 6 shows a simple device by which iron is straightened in the lathe. The bar is brought to a red heat and placed in the lathe, which is set in motion. The rollers being then forced against it by the cross-feed screw, it is made to run true in a very few seconds. F. A. H.

The board of education of Altoona has adopted a special course of instruction in the high school of that city to fit the boys for apprenticeship in the shops of the Pennsylvania Railroad. The Pennsylvania officials co-operate with the school authorities in the preparation of the course.

Echoes From the Oil Country—One Way of Saving Time.

The man that most foremen would pick out to send out of the shop to do repair work is one who is really interested in his work and who likes to push the job along, regardless of the kind of a job it is or the kind of people it is for.

Bob was a man of that kind, and when the foreman told him that the job in the shop would have to stand until he came back, and to try to catch the 2-o'clock train back, he was ready to work under all the steam he could carry.

It was seven miles by train to the place where he started into the woods, and something more than two miles in to the mill where the job was to be done. The train did not leave the shop town until a few minutes after 9 o'clock, and it was after 10 before he got to the mill.

The job was not much of a job, as things go. It was on the valve motion of the steam engine, and to save any question being brought up in the future, Bob had them get up steam so that he could run it before leaving.

He had told them that he wanted to get the early train back, and when the call to dinner came, the information also came that they had held the dinner back on his account, and that it was quite a lot after noon. Bob had been figuring somewhat on the time by the call for dinner. The usual time was 12 o'clock, but now his watch showed him that it was nearly 1. He did not know what time the train left the station, but he did know that it reached his home town at 2 o'clock, and that meant that he did not have a minute to spare. He was hungry, and thought he could make better time if he had something to eat; so, wiping off the rough of the dirt from his hands with a piece of waste, and without taking off his overalls, he sat down and made a grab for the food that was the nearest at hand and the easiest to get down. After a few minutes of this, he grabbed a piece of bread and meat in one hand and his bundle of tools in the other and started down the road. And it was really *down* the road, for the mill was several hundred feet higher than the railroad.

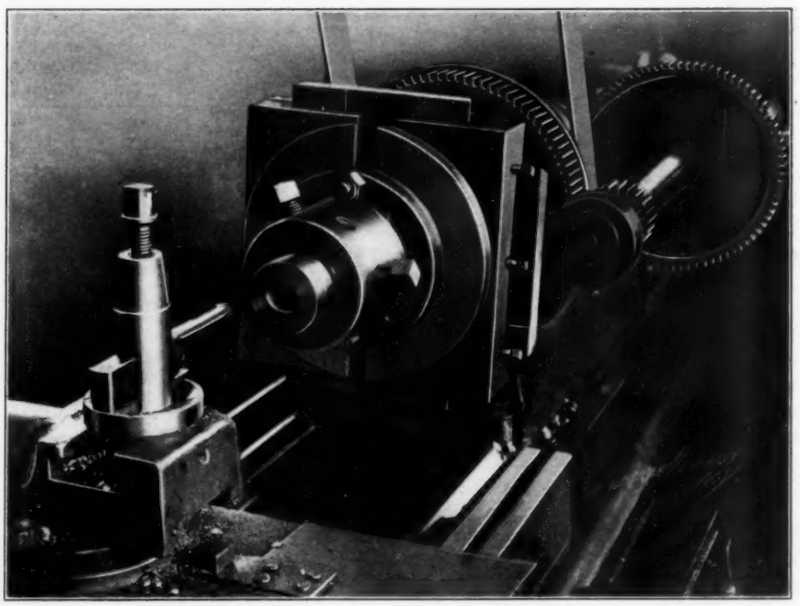


FIG. 4. ELLIPTICAL CHUCK BORING A DIE.

I did not mention it before, but this was in the winter. The snow was deep, and the road for most of the way did not lead anywhere but to this mill. About a half mile from the station it ran into the public road, but between that end and the mill it was poor and not at all well broken out. As soon as the food was eaten, Bob

settled himself to making what time he could. Some places he trotted, some he walked, and some he only waded. Several times he heard a locomotive whistle, and each time it spurred him up. The weather being bad, led him to hope that the train would be late. The shop was close to the railroad track, and he knew that the trains were often late in snowy weather. He always thought that he was pretty lucky, and perhaps he would be today. He was well warmed up when he struck the good road, but it was well beaten and he speeded up a little, and he was soon where he could see the station. The passenger train was not in sight. A freight train was standing on the siding, and that was a good sign, for it would have to get out of the way to let the faster train past. The faint echoes of a whistle that came from somewhere showed him that he did not have any time to lose, but he couldn't go any faster, although even at that he reached the station before he saw any signs of the train he was trying to get. After standing on the track for a minute, looking in the direction the train should come from, he went inside. He did not need a ticket, as he had gotten a return ticket in the morning; but perhaps that train was late, and he approached the station agent. The man was everything at this station, and was just then busy at the telegraph key.

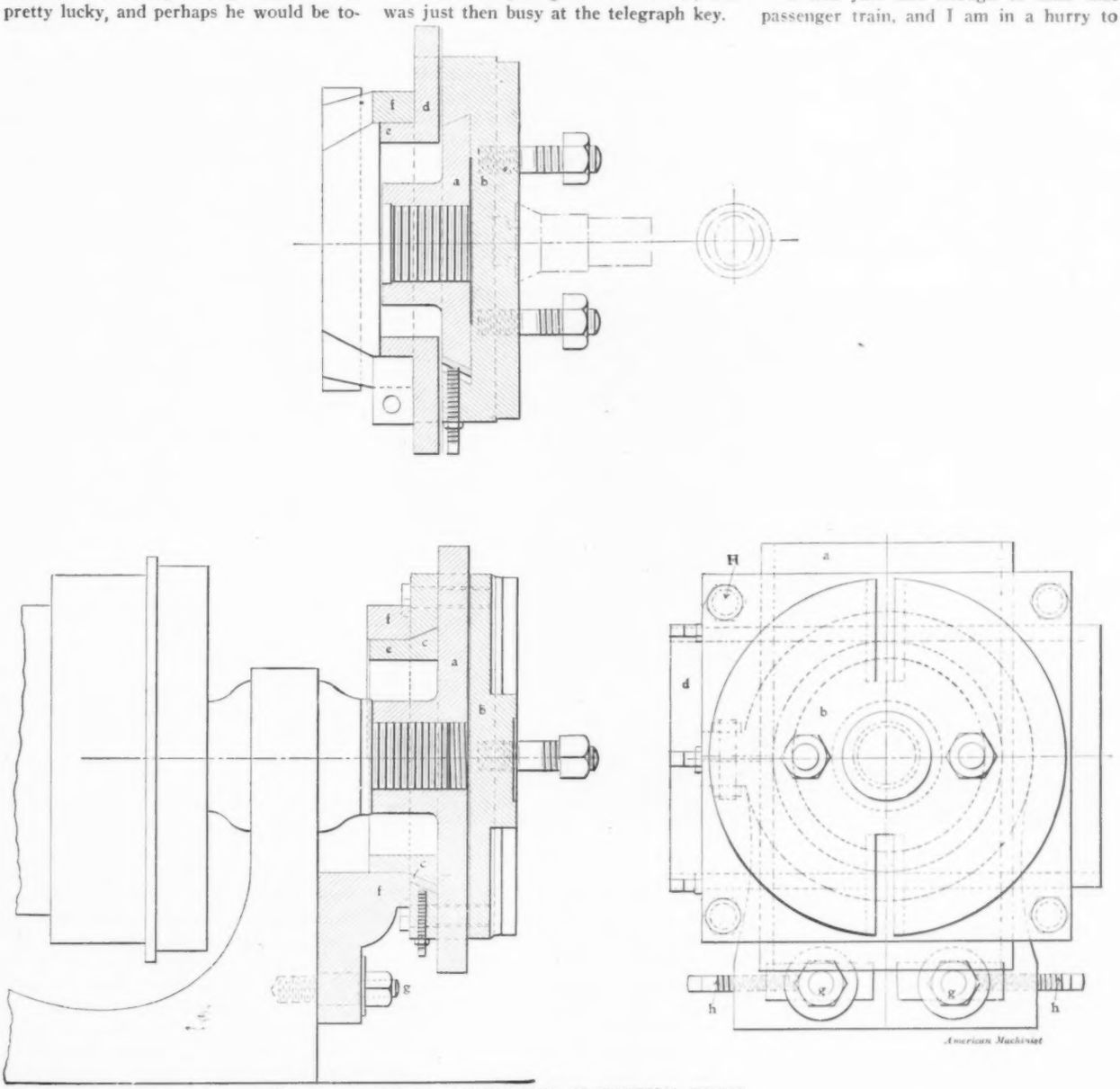


FIG. 5. CONSTRUCTION OF ELLIPTICAL CHUCK.

"Hello, pard. How soon will the passenger be along?" asked Bob.

"Six thirty-seven," came the reply.

"W-h-a-t?" said Bob. It was long drawn out, and expressed to some degree his surprise.

"Six—thirty—seven," again came the reply. It was slow and distinct, with a pause between each word, and could not be mistaken.

"Is that the first train that leaves here going west?" he asked.

"I expect that freight will go that way as soon as they get ready to pull out, but they can't carry passengers. The six thirty-seven is the first you can ride on."

Bob went outside and watched them couple up the freight. It had been opened where the wagon road crossed the track. The brakeman looked rather good-natured.

"I was just late enough to miss that passenger train, and I am in a hurry to get up to town. Do you think there is any chance for me to ride up in the caboose? I am dead willing to pay my fare if I can." Bob looked square at him, and knew that his overalls would help if anything would.

The other shook his head. "I wish we could, but this Pennsylvania is awful particular, and it might get us into all sorts of trouble if we did. It's a long train, and if it was warm weather you might get on up toward the middle, and as long

as a fellow didn't see you it would be all right, but it is too cold for that."

"I guess I might as well take it easy till evening. So long," and Bob turned toward the station, while the brakeman started toward the caboose. Through the window could be seen the man at the telegraph key. That is, Bob could see his back, and he could see the back of the brakeman. It was not so very cold, at least he had seen lots of colder days. There was nobody else around, and he was near the middle of the train. Walking a few car lengths forward he swung himself up between two freight cars just as the train began to move.

Did you ever observe the end of a box car? Bob was between two of them, where he was out of sight of anyone on the train. He had a timber not over 10 inches wide to stand one, and there was a brake rod that ran up to the brake wheel on the top of the car. At the center of the car his foothold was a trifle wider, and he had an idea that the drawheads and couplings somewhat prevented the snow from flying up so much at that point as it did over the wheels. It was surprising how the snow came up from below and down from above and in from both sides, and how the car bumped, now this side, now the other. Surely something had happened to the roadbed since morning, judging by the way the car hammered over the rail joints, and then that train had a trick of stretching out to the farthest limit and then coming together with a crash that sometimes made Bob fear that he would be jarred from his not any too secure perch. He hooked one arm around behind the brake rod, and, for a change, would occasionally brace one leg forward to the other car; but the way the cars pulled apart and came together again made this uncomfortable and somewhat dangerous, so he gave it up. He soon changed his mind about the weather, and thought it was the coldest he had ever known. While he had never studied the heat-carrying properties of air, the way that wind sucked the heat out of his frame was an educator with a lightning system. He had often watched freight trains, and did not think they ran much over fifteen miles an hour, but to judge by the way the wind was working on him, it must be going a hundred at least, or else there was a terrific storm blowing from the west. More than likely there was a storm, for it was certainly hours since he had been so rash as to jump that freight, and if this thing continued much longer he would be an icicle. He stamped his feet and swung the free arm, and changed arms with the brake beam and swung the other one; then a new horror came to him. This might be a through freight and it would not stop at his town. It would have to slow down for the crossing where this line crossed another one, and he made up his mind if it did he would have to jump, and he was awful cold and stiff to do a good job of jumping. It seemed so long since he had got on that he had begun to wonder if it could be possible that they had run by his town, when the train began to slow up and he could see where they were. He swung his bundle of tools around his neck, so as to leave both hands free, and got down on to the step and waited. The motion was still faster than he liked, when the locomotive began puffing again, and he knew it was now or never, and he let go and went rooting through the snow on his hands and knees. He was not hurt; and as soon as the train was past he started up the track as fast as he could go, glad of a chance to warm up a little.

As he passed the station he saw a thermometer hanging out and took a look at it. Twelve below zero. He grinned rather sheepishly to himself and went on.

"Hello!" said the foreman, as he came into the shop. "I thought you must have missed the train, when you did not show up. You must have stopped for a drink." This drink gag always annoyed Bob, for he prided himself on the fact that he was a teetotaller, and the foreman knew it. "But I don't blame you so very much for it on a day like this."

"Missed her and came up on the the freight," said Bob.

"You must have a stand-in somewhere. I never could get them to let me ride; you know they are liable to get bounced if they get caught at it, and that was the through freight that just went by, and they would have to slow up to let you get off."

"I'm not going to impose on them very often," said Bob quietly, as he went back to the job he had dropped to go out.

W. Osborne.

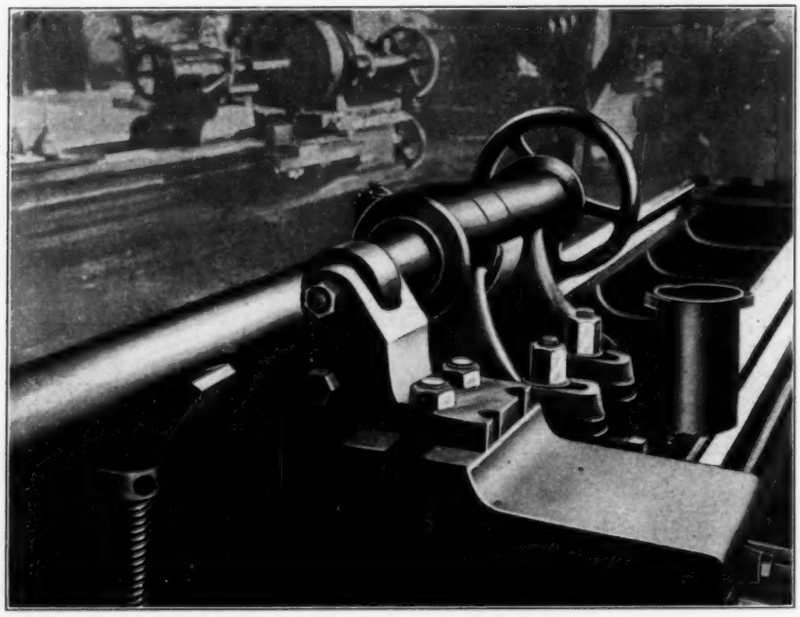


FIG. 6. STRAIGHTENING BAR IRON IN THE LATHE.

An Indexing Drill Jig.

BY GEO. F. POPPLEWELL.

The jig shown in plan, side elevation and sectional elevation in Fig. 1 was made for drilling the holes in the piece shown in Fig. 2. It will be noticed the holes are drilled at an angle of 3½ degrees to the center line of the piece; this angle and the position of the holes with relation to the common center line are very important.

The drawing shows very clearly the construction of the jig, which consists of a gray-iron base-plate *A*, planed and scraped at *a* to receive the slide *B*, which is also planed and scraped to a good working fit. The projection *b* carries the plunger-holder *C*, made from a mild-steel forging, and bored to receive plunger or lock-pin *D* and spring *E*. The knurled knob *F* is milled to suit the "V" in *C* and drilled to receive pin *G*, which passes through both plunger and knob.

Slide *B* is bored out to receive boss *c* on intermediate piece *H*, which is turned to a good working fit in *B*. Bushing plate *J* is bolted and doweled securely to *H*, and around the turned periphery of the bushing plate are the holes for lock-pin *D* to engage in. The ledge *d* on *J* is milled accurately to a distance from the center line of the jig, and forms a locating stop for the work to butt against. The hardened-steel V-block *K* centers the work and holds it when in position. It is held on mild-steel lever *L* by stud *M*, around which it can revolve; it also carries a hardened-steel block *N*, which is made a nice working fit in a milled slot in the bushing plate, to guide V-block *K* when lever *L*, which swings around stud *O*, is swung into position for holding the work.

Block *N* of course swivels freely on stud *P*.

The lug *c* on *J* is milled out to receive the end of lever *L* and take the downward thrust of thumb-screw *R*, which bears against a slight chamfer on the side of the lever to hold V-piece *K* tight against the work. Steel strips *S* secured to the base-plate prevent the body of the jig being lifted off the base. Hardened-steel bush *T* in the base-plate is for facilitating the setting of the jig directly central with the drill, after which it is clamped to the machine table. The functions of most of the details are so obvious that they require no explanation.

In making this jig the special difficulty lay in the spacing of the holes for the lock-pin *D* and the drill bushes, so I will confine these last few lines to the method by which we spaced these to insure their being correct. After intermediate piece *H* and bushing plate *J* had been doweled together, a scrap piece of metal was bored out a light driving fit for boss *c*, and plate *J* was then faced at the center, centered and turned, and a ¼-inch hole drilled in the center; this was to insure the bush plate being concentric with *c* around which it has to rotate. Plate *J* was then removed from *H* and mounted and bolted to a special arbor having a tapered shank fitting the socket of a dividing head; the spindle of the head was set central and at right angles to the spindle of the machine, and to divide into 360 degrees (two holes in the eighteen circle). The center line *x y* of the bushing plate was set in the horizontal plane, a suitable drill was fixed in the spindle of the machine and everything was ready for spacing and drilling the holes for the

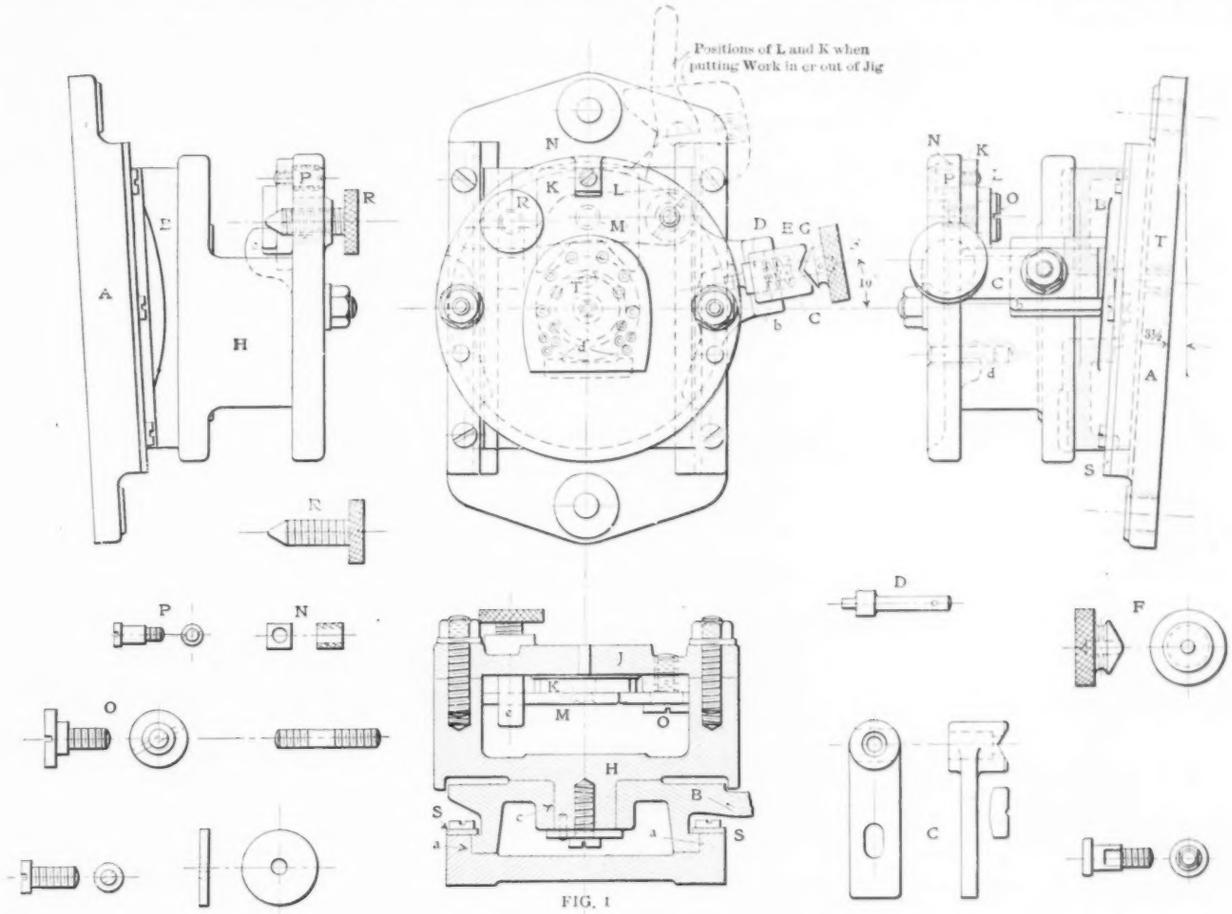
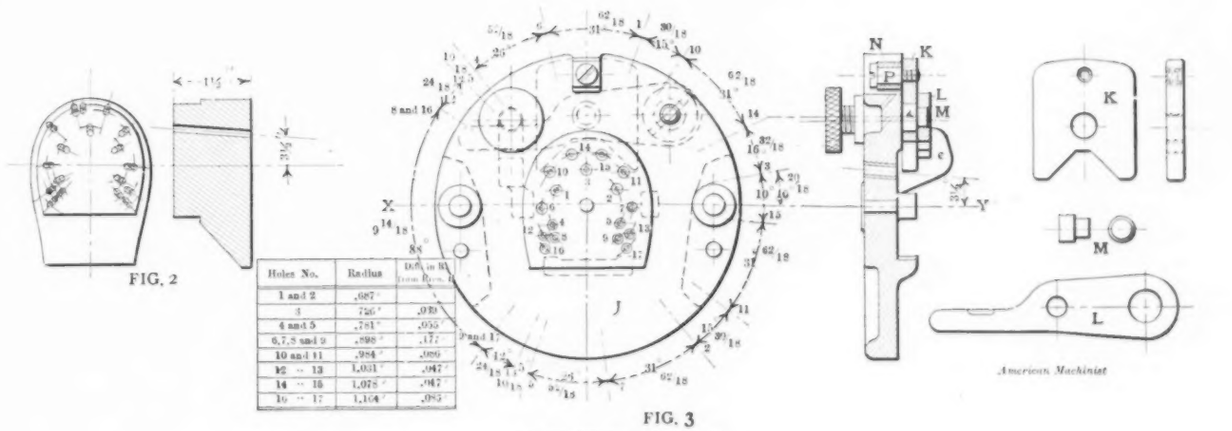


FIG. 1



Holes No.	Radius	Difference in Radius from Prec. Hole
1 and 2	.687"	
3	.726"	.039
4 and 5	.781"	.055
6, 7, 8 and 9	.898"	.117
10 and 11	.984"	.086
12 " 13	1.031"	.047
14 " 15	1.078"	.047
16 " 17	1.164"	.086

FIG. 2

FIG. 3
AN INDEXING DRILL JIG.

plunger *D*. Fig. 3 shows the method of dimensioning the drawing. It will be seen that the angle between holes is given and also the number of holes in the eighteen circle of the index plate to be spaced for each hole.

After this the jig was built up and set up on the face-plate of an engine lathe, having a graduated collar on the cross-feed screw, the center hole in the bushing plate *J* was set concentric with the lathe center and base plate *A* parallel with the lathe bed, plunger *D* being of course on top. The face-plate was then firmly locked in position. A center punch held in the lathe tool-post was set exactly central, and all back lash in the cross-feed screw was taken up. Now to mark off the centers of the bushing holes the cross-feed screw was rotated until the required radius for holes 1 and 2 (see Fig. 3 and table giving number of hole and its distance from the center) was read off on the graduated collar on the screw, plunger *D* was disengaged and plate *J* rotated until the plunger could engage in the hole 1; the center was then marked by the center punch in the tool-post. Plate *J* was again rotated until the plunger engaged hole No. 2 and the center again marked. The cross-feed screw was again rotated for the next larger radius which is .039 inch larger than for holes No. 1 and 2. The difference in the radius of the holes was given to facilitate the screw readings. After all the holes had been marked out in this manner the face-plate was unlocked, and each hole was set true in its turn and bored.

A newspaper tells of a man who sat on a limb of a tree and sawed it off between himself and tree because he was left handed, *and so* sat on the wrong side.

Shop-Tools and Methods.

BY F. J. LE CARD.

Fig. 1 illustrates a taper half-reamer about which there is nothing new, except the easy method of filing to the center when a milling machine is not at hand. By leaving the tip *a* straight for a short distance—like *b*—the micrometer can be placed at *b* and *c* to find the half diameter, filing or grinding the end *b* off afterward.

HARDENING AND TEMPERING SMALL WORK.

In Fig. 2 *d* is a piece of round copper rod drilled out for a receptacle for hardening small drills, taps, and so forth, and prevents over-heating when a strong bunsen or other blaze is used in tempering very small work. The piece, *e*, to be hardened is held loosely in the copper tube, and when plunged into the water or oil, shoots out into the liquid generally, and hardens without scaling. Very small work may thus be heated in a severe blaze without overheating, and the device will also hold the heat while passing to the oil or water.

Hair springs for watch balance wheels are hardened in copper boxes about ½ inch in diameter by ¼ inch thick over all. The box is made like a shallow cup with a hole in the center, through which an arbor is passed. This arbor has three or four slits into which the ends of as many spring bands are inserted. These bands or flat wires pass through cuts in the rim of the box, and as the arbor turns, are coiled around each other until the box is filled; the wires spacing the coil in each spring when separated after being hardened. The arbor is removed and a copper cap fitting the box is wired down with copper, and the whole is ready to heat up and plunge into cold water. The copper being a good conductor, chills the spring quickly; and the springs, being confined, come out clean and white. The boxes are made in quantities.

Figs. 3 and 4 are bessemer rods for holding work as shown, while drawing the color in a strong blaze. The work *f*, in Fig. 3, can be highly polished, and if made with small teeth, like a milling cutter, can be drawn very evenly. Then the rod *g* can be brightened up quickly in a lathe for another piece. The same applies to Fig. 4.

I have found a strip of flat stock, like *h*, Fig. 5, the handiest and safest thing for holding small screws in the fire, especially headless screws with a few threads, either for hardening or case-hardening. Where compelled to use a charcoal fire or hard-coal stove for tempering, as I have been many times, I use, even for larger screws, a long, flat strip like that shown, and run no risk of losing the work in the coals.

FIG. 1

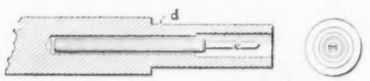


FIG. 2

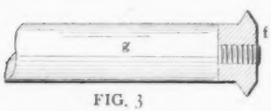


FIG. 3

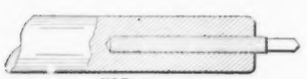


FIG. 4

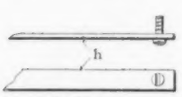


FIG. 5

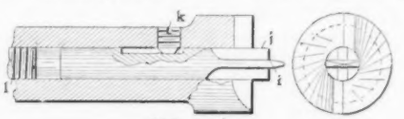


FIG. 6

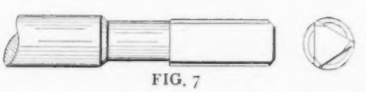


FIG. 7

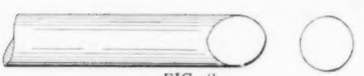


FIG. 8

FIG. 9

SHOP TOOLS AND METHODS.

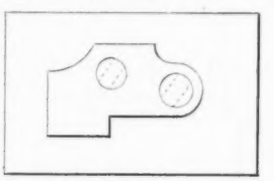


FIG. 10

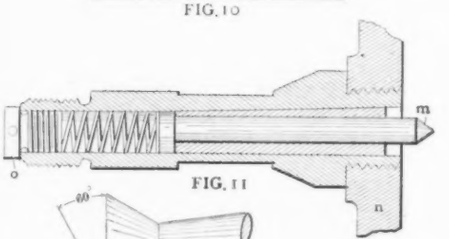


FIG. 11

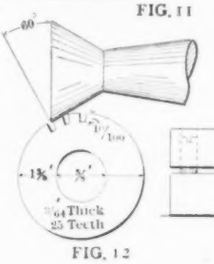


FIG. 12

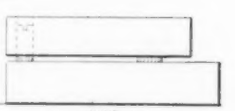


FIG. 13

American Machinist

CENTERING AND FACING TOOLS.

Passing to another line of practice, Fig. 6 represents a turret tool for centering and facing at the same time where the facing cut is heavier on one side of the work. As the center drill *i* enters the work, it is followed by the guiding part *j*, left in the milling of the tool, which acts with the drill as a counterbore tit. This can be ground away as the drill is sharpened; and the tool has clearance and strength, with a thin but stiff drill. The set-screw *k* on the flat does away with high pressure on the screw-driver; and the screw *l* prevents any back thrust.

EMERGENCY REAMERS.

Figs. 7, 8 and 9 show small emergency reamers easily made by hand. The first I find quite a durable and reliable tool, it working smoothly and accurately, espe-

cially in brass. The one in Fig. 8 is sometimes good for one or two holes. To make, take a piece of odd-sized drill rod; it may be self-fitting. Fig. 9, to work well, should be quite thick in proportion to its width, and not backed off much on the sides.

Quite common practice for a quick call is to round the corner of a twist drill and use it for a reamer. It is easily reground.

FACE-PLATE WORK.

Fig. 10 is intended to illustrate partially a method of holding work where the holes to be bored out on a face plate are large in proportion to the work and the latter is liable to be moved in roughing out. In such an event the holes can be drilled out approximately in a drill press or lathe; and then the centers can be laid out correctly on brass pieces inserted in the holes, as indicated by dotted lines.

After the work has been swung up and indicated the brass plugs can be easily pried out without deranging the work. The work in Fig. 10 is shown mounted on a supplementary plate by soldering; a good way where the clamping surface is small. Such a plate, with holes tapped in it for clamp screws, is handy for clamping to the face plate instead of mounting the work directly on the face plate.

A PUMP CENTER.

Fig. 11 is a tool called a pump-center, from its working on the spring behind it. It is found indispensable in some shops, especially on bench lathes, and never known in others.

Suppose it is desired to bore a hole in a piece that has a flat surface on the side, marked or pricked, while the opposite side is irregular; or the whole or part of a circle is to be turned in the back of a die, or a point found opposite any given point: then put such a locating center on the center *m*, press it up to the plate *n* and clamp or fasten it there, and bore or turn the work. If it is necessary to go through the piece, the screw plug *o* can be removed and the center *m* taken out or pushed back by the boring tool.

MILLING SAWS.

Fig. 12 shows a milling-machine saw that does good work on tool steel. The saws are used in this case in cutting off ends of 1-10 inch drill rods in rows of a hundred or more. They are used with a gang cutter and stand a long time, and they can be ground on the face. They are cut in quantities on an arbor and backed off with a 60-degree angle cutter on the second tooth from the center line, as seen.

A PAIR OF HARDENING BLOCKS.

Fig. 13 shows a pair of hardening blocks. The upper one is provided at the two rear corners with adjusting screws, which are set out from the plate a distance equal to the thickness of the work to be hardened. In this way the work makes with the two screws three points of contact and the plates come flat on the saw. Harden with fish oil preferably, and do not let the dirt accumulate on the plate.

The saws, a hundred lot, came dead flat, hard and tough. They were heated on a strip of sheet metal so they could be slid onto the plate readily.

College Shop Experiences—I.

BY HARRY MARQUETTE.

The college was located in a beautiful valley among the great wild Western mountains. Like most Western institutions of the kind, neither the board of regents nor the students were blessed with affluence. As a consequence, the former economized and the latter "bached." Only a true son of the mountains and of the alkali knows the full meaning of this term. The bachelor communities of our Western colleges, with their endless round of fried steak, sour-dough bread, boiled potatoes and coffee, together with many other of the picturesque conditions of the frontier life, are fast passing away.

The new professor of shop work was not altogether a tenderfoot, as he had had the pleasure of planting considerable mining machinery in exceedingly inaccessible places, but this teaching business was new to him. When he alighted from the train and looked across the valley at the group of buildings above the low cliffs on the opposite hillside, he could not help but stop and wonder which was to be his domain. He finally came to the conclusion that the building in the foreground with the general pancake style of architecture, must be the one where he was to hold forth. A few inquiries and a visit to the president's office confirmed these surmises and within an hour he was handed a bunch of keys and told to go down and take possession of the college shops.

The building was a one-story, rambling affair, which had been designed by a college professor who evidently had more theories than practice. It was composed of brick walls forming a rectangle about 60 feet square. In the center the roof was sunk 6 feet or so below the surrounding level, making a small area in the center in which the ceilings were about 6 feet lower, so as to afford a series of high windows around the interior of the outer rooms. The rooms under the low roof were lighted by skylights, and utilized as toilet-room, toolroom, storeroom, etc. The roof was the distinctive feature and crowning triumph of the structure. The designer had spent some time at sea, and had become convinced that the best possible roof was a canvas-covered structure. Acting upon this principle he had secured some magnificent fir timber in beams 14 inches square, and placed them over the outside walls. In the center of the building some of them rested on the walls of the areaway, while over a portion of the shops two timbers 34 feet long extended from the outside walls to the center, where they were butted together. They were supported about 20 feet from the outside walls by posts, and the central portion allowed to project over the posts as a cantilever. The roof timbers had a slope of about 18 inches in 30 feet; in other words the center of the roof was about 18 inches higher than the eaves.

One of the great arguments presented by the professor-architect was that these big beams would make rigid, permanent places to fasten hangers for shafting. The beams were placed 12 feet apart, center to center, and the roof beneath them was composed of 3½-inch fir plank, tongued and grooved together and arranged to span the space between the beams. The roof was covered with canvas and painted like the deck of a steamboat. For pure cussedness and profanity-provoking propensities it is doubtful if a more efficient roof could be put on any shop; but all of its bad qualities did not come out at once, and may serve for another story. Nevertheless the new professor in his first inspection saw that with the arrangement of hangers, the placing of pulleys and location of machines then in use, there was sure to be trouble ahead.

In the first place the machines were a most decidedly miscellaneous collection. In the wood shop there was a set of machines which had equipped the planing mill used when getting out the stuff for finishing several of the college buildings, and this equipment was excellent. To this equipment had been added half a dozen of the lightest, cheapest possible turning lathes, and a very light, rickety circular saw. Of the wood-working equipment and the troubles which it provoked there will be more to say later.

There was a series of work-benches running around the walls of the room, and the heating equipment consisted of a series of steam coils hung about 14 feet from the floor. In the wood shop the drip from these was conducted into a galvanized iron boiler such as is used in connection with the water-heating arrangements attached to the water-back of an ordinary range in a private house. This reservoir had been introduced to collect hot water for use in the wash basins in the toilet rooms during the winter months, but subsequent investigation proved that the drip pipe was so located that the reservoir and about half the steam coils would normally remain full of water, thus cutting down the heating surface very materially. The lumber racks for the storage of lumber were located in the room in such a way that it seemed as though their designer had wasted a considerable amount of gray matter in determining how he could obstruct the work of the room with these racks to the greatest possible extent.

Upon visiting the iron room a certainly

heterogeneous collection of tools presented themselves. First there was a 20-inch lathe made by a good concern and in fair condition. Adjoining it were two of the cheapest possible excuses for 12-inch lathes. There was a very good 30x30-inch by 8-foot planer, a cheap ramshackle drill press, a Browne & Sharpe universal milling machine, and a dilapidated grindstone. The supreme feature of the equipment, however, was a turret lathe with a heavy bed supported by box pedestals and intended for manufacturing brass fittings, etc., but for this lathe there was absolutely no equipment, not even a chuck, nor a single tool for the turret.

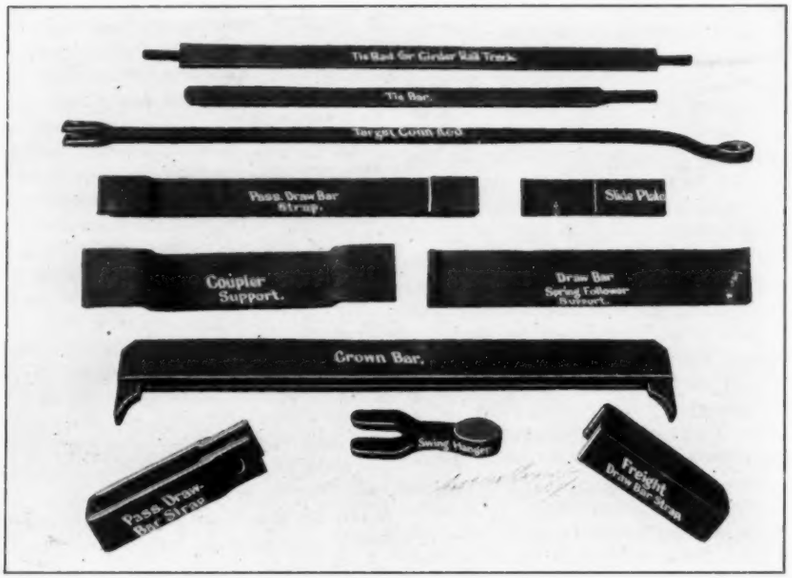


FIG. 1. WORK OF THE FORGING MACHINE AND BULLDOZER.

In another room was a 20,000-pound testing machine, all by its lonesome. The toolroom was a splendid example of how not to do things. Two of the walls were board partitions, and two were rough brick walls. The equipment for taking care of tools consisted of a set of shelves against one of the wooden walls. There was a fair equipment of tools, but they were piled upon the floor or upon these shelves in a heterogeneous collection.

When studying the college catalogue to obtain some idea of the equipment he would have to work with, the newcomer had noticed a statement that there was a toolroom equipped with "all modern appliances" and a carefully worked-out check system for issuing tools to the boys. A search for the aforesaid check system finally resulted in the discovery of about 400 brass checks wrapped up in the packages in which they had been received from the maker. After his brief survey, a visit was paid to the president, and it was ascertained that the professor in charge of the department which included the shops would not return until the day school opened; that there were no funds available for purchasing supplies for immediate use, and that there was no help available to assist in getting the shops ready for the students. A man, however, who has had to erect or repair machinery in frontier mining camps is not likely to be daunted by a few trifles, and so the new professor's coat came off, his overalls went on, and for several days he made things hum around that shop.

The first thing was to get those shelves in the toolroom away from the wooden wall and against the brick wall, so as to leave the wooden wall to hang up tools on, as it was certainly easier to place hangers and screws in an orderly manner in wood than in hard brick. The check-board was made and checks gotten into place, and the available sets of wood-working tools distributed into the bench drawers. It had been stated that he might have twenty-five students in his wood-working class, and as there were twenty-six sets of tools, the prospect was encouraging. On opening day, however, a class of over sixty showed up for elementary woodwork, a class of five for patternmaking, and fifteen for machine work. Later in the year a number of other recruits were added to the wood-working class, and as a consequence the professor realized that he was "up against it" with a vengeance.

To make things more interesting, some of the old students buttonholed him and told long stories of the chaotic condition of the work in the shops for the past two years. The problem was solved in this way: the boys were all called together and in a few words the facts stated about as follows. They were there to study and the professor to instruct; that if they wanted to get the most return for the money they or their parents were spending, it was up to them to help and not to hinder the work of the shop. By all pulling together, everything would go nicely. Fortunately, it was discovered that the classes contained several men who had had experience in sawmills, at carpenter work, or in small repairing machine shops. These men were picked out and placed over the others as temporary foremen, and the work of the shop carried on just as work in a factory would have been. One of the old sawmill men was put in as foreman of the planing-mill machinery, another over the lathes, and one of the men with machine-shop experience as machine-shop foreman. A couple of bright boys were put in charge of the toolroom, and things started off smoothly. The foremen were changed every few weeks, the best workmen in the class being ad-

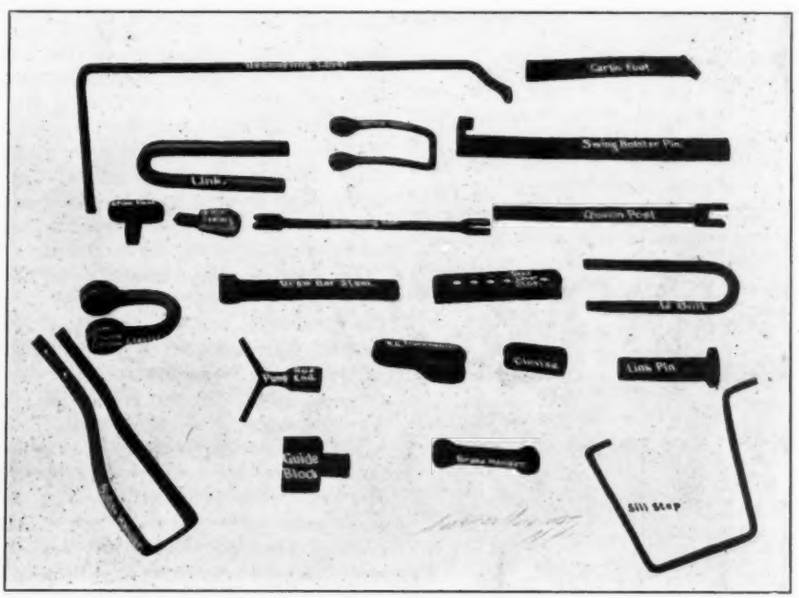


FIG. 2. WORK OF THE FORGING MACHINE AND BULLDOZER.

vanced to these positions, and this competitive feature made many of the students strive hard for the honor.

Everyone knows that for consummate deviltry the machine-shop cub is passed only by the "prept" or "freshie" in college; but at the same time if you get on the right side of the boys in the shop or in the college, you can be sure of the heartiest kind of support; and the success of the year's work in the above mentioned shop was largely due to the hearty support of the boys themselves.

The Metric System in Australia.

The secretary of the Decimal Association writes us that he has received a letter from the General Council of Chambers of Commerce of the Commonwealth of Australia, stating that at a meeting of that body, held in Sydney in June last, the following resolution was passed:

"That this General Council of the Chambers of Commerce of the Commonwealth of Australia views with satisfaction the increasing public interest in the metric system of weights and measures, and expresses the hope that it may very shortly be adopted for England and the Empire generally, and recommends that such legislation may now be framed in the Commonwealth as will enable us to at once follow the home country in this change."

Dies for the Ajax Forging Machine.*

BY S. J. UREN.

In a shop where there are orders for a large quantity of car and locomotive forgings coming in daily, the first thing that enters the foreman's mind is how to get the work done quickly, and I find by experience the best way is by the use of the forging machine and bulldozer.

The large number of forgings that can be turned out by these machines daily is surprising, and no well-equipped shop should be without them.

In our 4-inch forging machine we are turning out the following: Swing hangers for passenger car trucks, bolsters for all baggage and postal cars, crown bars for locomotive boilers, crow-feet for locomotive boilers, drawbar straps for baggage and freight cars, connecting rods for S. P. switch stands, slide plates for switches, and other forgings too numerous to mention, some of which are shown in Figs. 1 and 2.

In designing the dies for the work to be done on these machines, the first thing to do is to figure out the amount of stock required to make the piece required which will give the length of die to be used. Fig. 3 shows a swing hanger for passenger car trucks, with the dies and headers for making it. For stock we use two pieces of 7/8x3x19-inch iron, which we lay together, put them in a small oil-fired furnace and in a very short time we have a welding heat about ten inches long on them. They are then placed in the lower space of the dies and the lever is operated. The dies close and the header enters them, the back-stop on the machine holding the stock from slipping back, and in an instant the two pieces are welded together and the head is formed. The stock is then turned end for end and placed in the upper space of the die, and on operating the lever again the dies close and the taper mandrel enters the die, splits the two pieces of stock apart, and forcing them into the die, completes the hanger, as shown in the lower right-hand view of Fig. 3 and also in Fig. 1. We make from 50 to sixty of these hangers per day, and it does not take long for a machine of this kind to pay for itself.

Care must be taken in setting dies in the machine and all bolts must be well tightened before starting. Fig. 3 gives all dimensions of the work, the dies and the headers. The die seat is 21 inches long when the dies are closed and the header block is at the end of its stroke. The space between header block and dies is 4 1/8 inches. When shorter dies are used, the punch or header must be increased

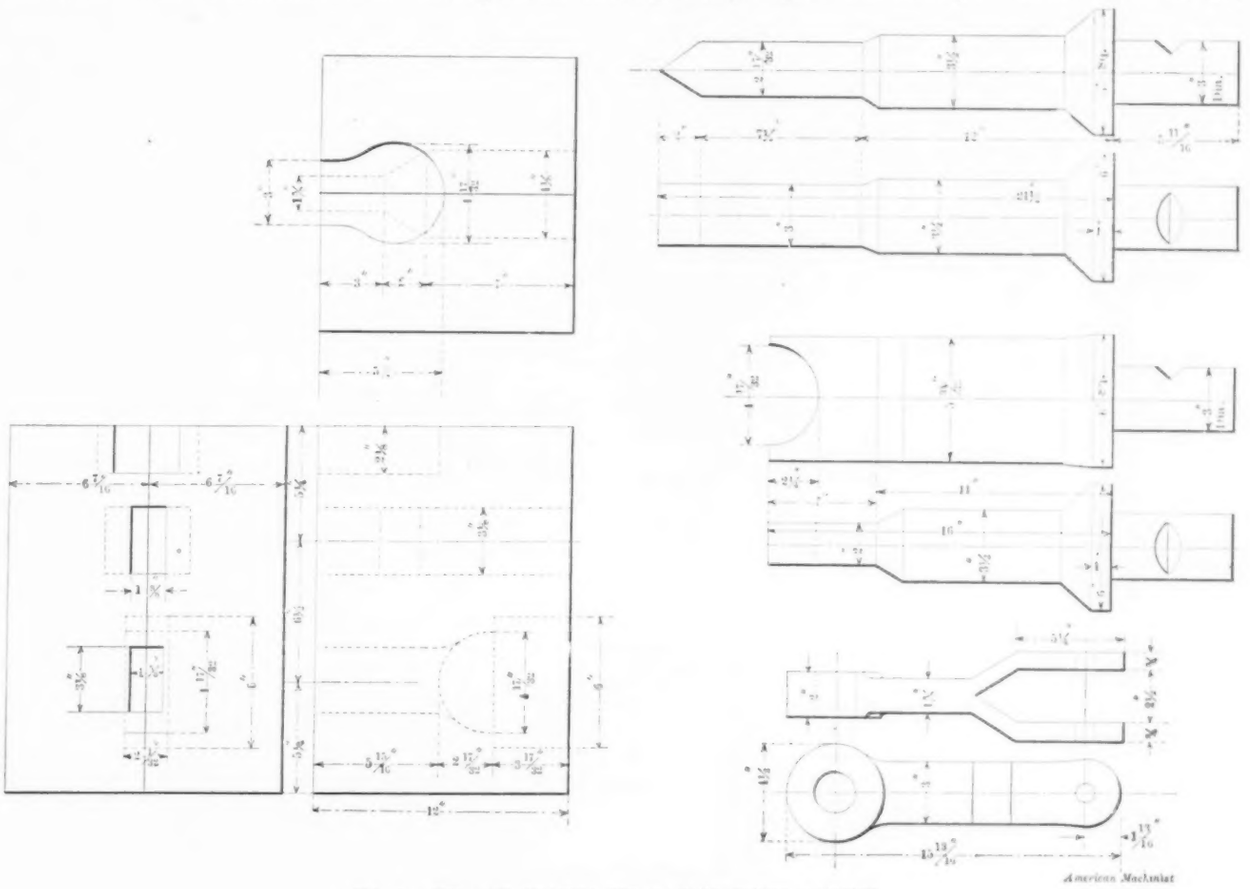


FIG. 3. DIES AND HEADERS FOR MAKING SWING HANGERS.

*A paper read before the Pacific Coast Railway Club.

in length in the same proportion. As the length of dies is decreased when headers, punches or mandrels enter the dies, the distance they go into the dies must also be increased.

In making the bolsters for the tea and silk cars recently built in the Sacramento shops, we take our 1x12-inch bars, cut them off 2 inches longer than the length required, lay a piece of 1x5x12-inch iron on the end—which allows 1 inch on each end of the bar for upsetting and welding—get a nice white heat on the end of the bar, place it in the machine and press the lever down. The dies close, the header comes up, hits the end of the bar, welds and presses it into shape, and we have one end of the bolster completed. Reversing the piece and going through the same operations, we have a bolster completed in quicker time than it takes to explain it. I find by testing this class

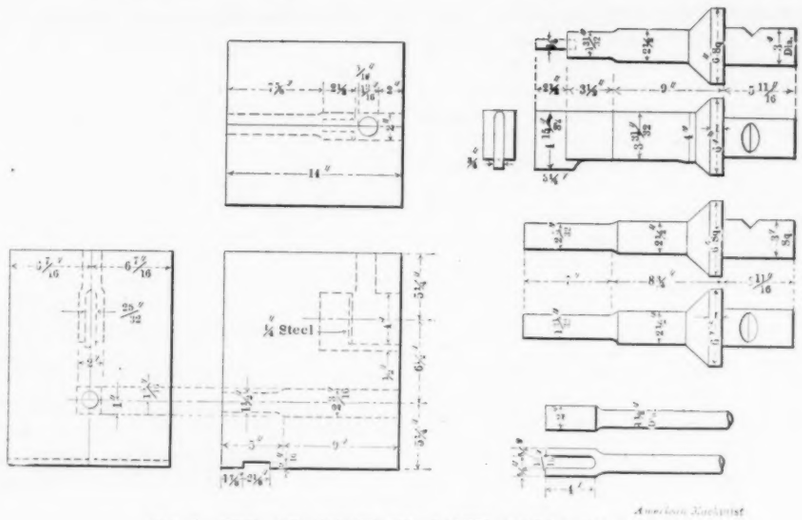


FIG. 5. DIES AND HEADER FOR TARGET CONNECTING RODS.

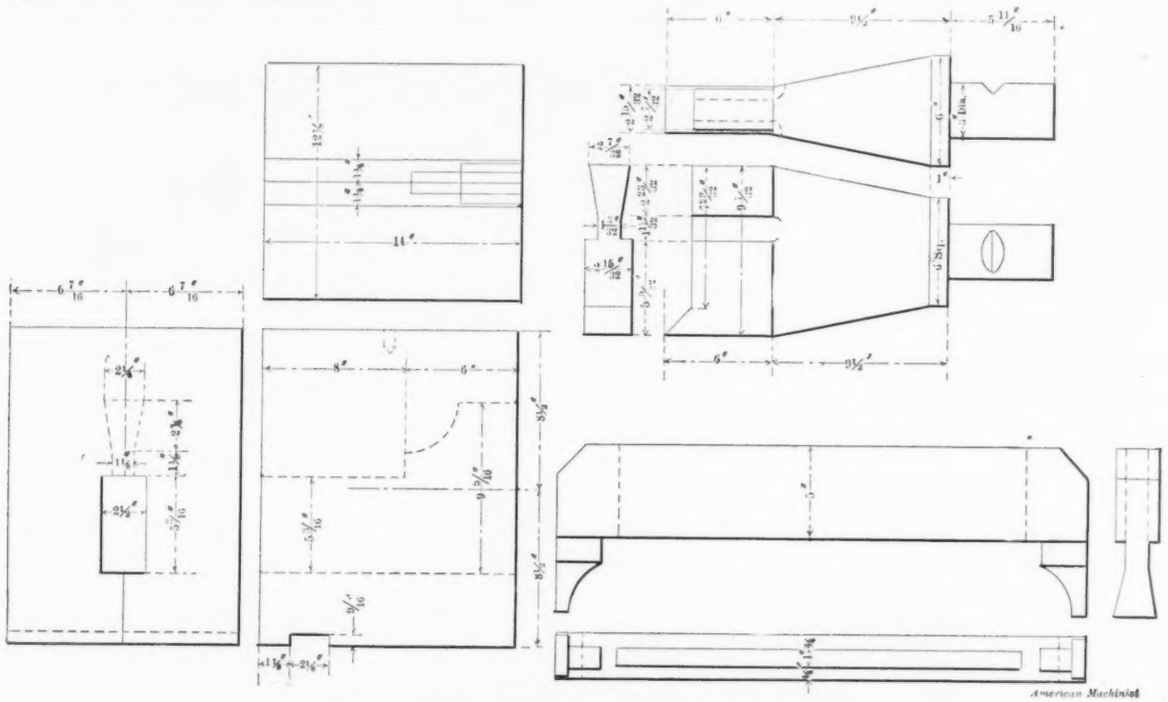


FIG. 4. DIES AND HEADER FOR LOCOMOTIVE CROWN BARS.

of work by the steam-hammer process, that it will stand a better test than similar work done by hand. These ends are put on at the rate of twenty to twenty-five per day.

Crown bars for locomotive boilers are made in a similar manner, by laying a piece of 1⅛x3x9-inch stock between two pieces of ¾x5-inch bars of any length required, the whole being welded and pressed into shape by one operation. The dies and header for this piece are shown in Fig. 4.

We have a great many target connecting rods for S. P. switch stands to make in the Sacramento shops, and this is a simple job for this machine. We take our bar of 1½-inch round iron the required length, get a white heat on about 11 or 12 inches of it at one end, place it

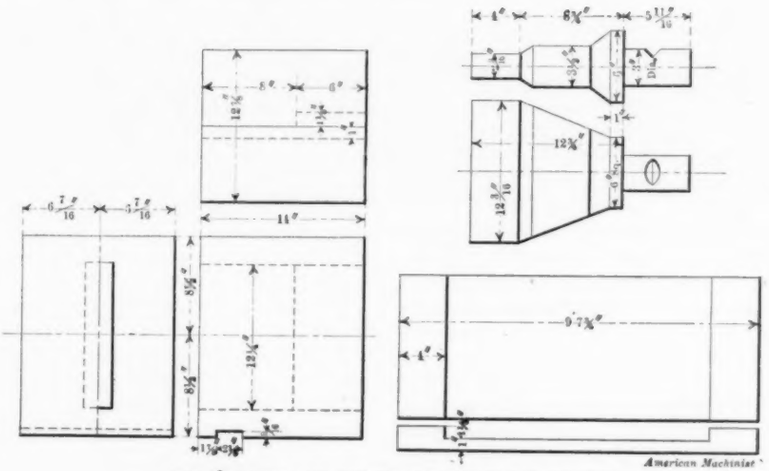


FIG. 6. DIES AND HEADER FOR DRAW-BAR STRAPS.

in the lower portion of the die shown in Fig. 5, and press the lever. The plunger comes up and upsets an end on the bar 2⅛x2x4½ inches long. We then take it out of the lower portion of the die, place it in the upper portion in a vertical position, when the dies close and the punch completes the jaw. We then take the rod to a 3-inch forging machine that we have close by and upset the other end. This takes but a very short time, and we have a target connecting rod completed without a weld. The idea in taking these rods from one machine to the other is to save time in changing and setting dies.

The bulldozer, as well as the forging machine, is a machine that should be in every blacksmith shop where there is a large quantity of bending and forming to be done, such as drawbar straps for passenger or freight cars, arch-bars for freight or tender trucks, side-sill steps, uncoupling levers, carry irons, corner irons, links and a large quantity of other wrought iron work that is used on cars and locomotives.

The face of the machine, which is constantly in use in the Sacramento blacksmith shop, is 14 inches high. 5 feet 4 inches wide, and has two grooves running the width of the face, cut out the same as the grooves in the bed of a planer.

We have two rollers, simply constructed, that we fasten to the face of the machine with the bolts slipped in the grooves. Consequently we can shift these rollers, to bend straps, from ½-inch width of opening up to 5 feet. When any material has to be bent at right angles, we slip one of the rollers out. The plate on the back-stop of the machine is constructed similarly to the face-plate, and we fasten all dies, formers and mandrels to this. The material is held in the formers or mandrels, before bending, by a hinged clamp made for the purpose. The bulldozer we use is a No. 7, and I think is large enough for all railroad purposes.

Continuous Double Diagram Indicator.

The Cipollina indicating apparatus, made by Dobbie McInnes, Ltd., Bothwell street, Glasgow, Scotland, combines in itself a double indicator with single paper drum and a time and revolution recorder. It works automatically, diagrams being taken simultaneously from both ends of the engine cylinder, and it records every revolution of the engine and shows the time taken on a given test. As a piece of mechanism, the combination is exceedingly well made, and, although it might be thought to be bulky, it is in its overall dimensions but 9 inches long by 6 inches broad by 8 inches high.

Two illustrations of the appliance are given and from the front view (Fig. 1) it may be seen that the two indicators

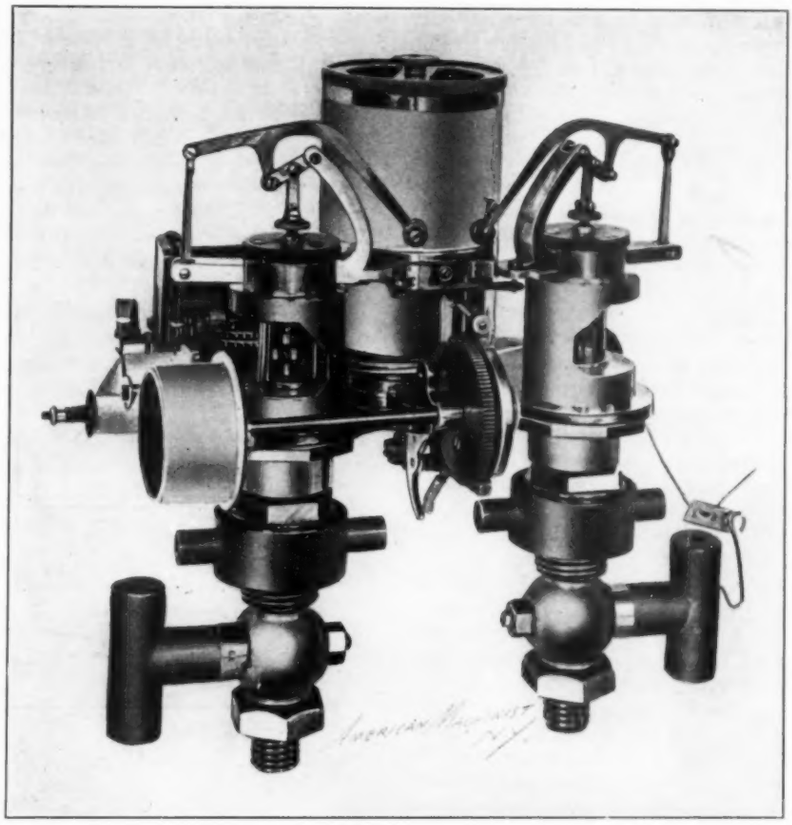


FIG. 1. SIDE VIEW OF CONTINUOUS DOUBLE DIAGRAM INDICATOR.

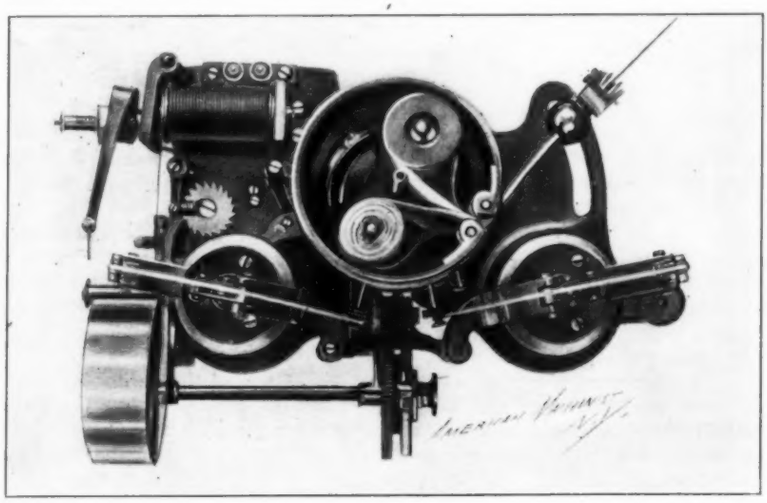


FIG. 2. TOP VIEW OF CONTINUOUS DOUBLE DIAGRAM INDICATOR.

employed are of the well-known McInnes-Dobbie external pressure spring type, with cylinder caps, coupling nuts, cock handle, etc., sheathed with vulcanite preparation for the protection of the operator's fingers. Regarding each indicator, it will be sufficient to say that the piston is of steel, case-hardened and of a special design, with lubrication chamber, the piston rod itself being of steel tube. The whole is designed for high-pressure steam, while by means of the parallel motion the piston travel is multiplied six times at the pencil. The cylinder is of parallel bore throughout, so that it is easily cleaned. The indicator is arranged so that the motion and the piston will come away all in one piece, and there is, consequently, no trouble with loose parts. The metallic paper on which the records are made is carried on two spools inside the central drum, as shown in Fig. 2. The roll is about 18 feet long and will accommodate about 50 double diagrams. These from the two ends of the cylinder are superposed, but not exactly. Although the simultaneous diagrams cannot exactly coincide in length on the paper, we understand that they will, in future instruments,

be brought closer together than is here illustrated by the pencils in Fig. 1. The knob, too, for the pencil, shown at the end of each arm, is to be reduced for lightness.

The paper is carried from one spool out between rollers and so around the drum, back again between other rollers to the second spool. The diagrams are not taken at every revolution, but at definite intervals, according to the gearing employed. Connection is made by the cord to the engine in the ordinary way, the adjustable guide being illustrated better in Fig. 2. In this way the drum reciprocates at each stroke of the engine, and if the indicator cocks are open the pencils rise and fall with the change of pressure. Further, at each stroke of the drum a spindle projecting below is lifted by means of an internal cam. In turn it moves another cam, which will be seen toward the center of Fig 1, beside a ratchet wheel. The latter, therefore, turns through one tooth at each revolution. Beside this wheel is a cam wheel, the smooth face of which is clearly shown. This face bears projections which lift a pawl on top of the cam, and this, in turn, by means of a cross-connecting piece, carries the two pencil points against the paper. Then the two diagrams are taken and the pencil points are subsequently released. The paper is then drawn forward so that a clear surface is again presented. The method by which this is arranged can best be understood by reference to Fig. 2. Usually all the parts of the paper drum rotate together. But, to move the paper forward, one spool is stopped by means of a ratchet device underneath, and thus the necessary relative movement between the paper and the drum is obtained. The number of teeth in the ratchet wheel in front of the instrument combined with the projections on the cam wheel determine the number of diagrams taken compared with the number of revolutions made by the engine.

With 100 teeth and two projections, diagrams would be taken at every 50 revolutions, but wheels are also supplied so that the diagram may be taken at periods of 25 or 100 revolutions. A small adjustable pencil draws a continuous atmospheric line. This tracer is set by opening the ordinary indicators to the atmosphere and marking, the position thus obtained being suitable for the whole series of diagrams. The paper is guided at the top and bottom by bars on the drum and thus it cannot shift vertically and so make the diagram incorrect.

The time and revolution record is made on a second paper drum at the left-hand side of the instrument. Motion is obtained from the large paper drum by means of a pawl shown in Fig. 2, which in turn actuates the ratchet wheel at the left of this illustration. This in turn moves a curved lever bearing a pencil point. This records each movement of the main drum and therefore every revolution of the engine, and it is arranged to miss at each tenth stroke, leaving a wide space so that the number of revolutions recorded may be read in tens at a glance. To register the time, the pencil shown to the extreme left of Fig 2 is used. A clock with an alarm device is necessary, connections being made so that a current passes at each half minute or any other suitable period. Then, by means of the coil shown at the top of the illustration, the pencil point is moved whenever the contact is made and thus, instead of tracing a straight line, the pencil marks the jerk, while this line, being drawn above the revolution record, shows the number of revolutions for a given period of time.

Although new as regards general use, this appliance has been employed privately and successfully in one of the European navies for about two years. Apparently complicated, it is really a simple combination which requires very little attention when adjusted and attached. Of course it can be applied to any engine, but it is specially applicable for reference work, as the records can show no personal bias. Further, being automatic, it is claimed to be particularly suitable for use on locomotives and torpedo boats.

Students of Sibley College, Cornell University, have ordered designs made for a bronze tablet, which they will erect in memory of the late Dr. R. H. Thurston, formerly director of the college. The tablet is being designed by Prof. H .S. Gutsall, of the College of Architecture, and will be erected in a stone niche of the new Thurston Hall of Engineering, now in process of construction.

In Cambridge borough butter is sold by the yard; each yard is supposed to weigh a pound.

A Set of Forging Dies.

BY P. SANDIESON.

The first pair of forging dies described are for use on a pneumatic and the second on a steam hammer while performing the operation shown, and they afford a good example of methods and means used to obtain results in an up-to-date forge. The forging illustrated in Fig. 1, in its successive stages of first heat, second heat and finished forging is a brake beam as supplied for the bogie and four-wheel stock of the New Zealand railways.

Fig. 2 shows the dies for performing the operations under first and second heats, the modus operandi being as follows: A piece of soft steel, 2¼x4 inches and 17¼ inches long, is brought to almost a white heat for five-eighths of its length and placed under the dies at *A*, where the eye is just stamped out or formed, when by means of the flat faces *B* and the inclined surface at *C* the material is drawn out until it assumes the form shown in first heat, Fig. 1. Of course it requires the repeated application of all three parts of the die to produce this result. During the finishing blows the faces of the dies are sprayed with water, which produces a very smooth surface on the forging.

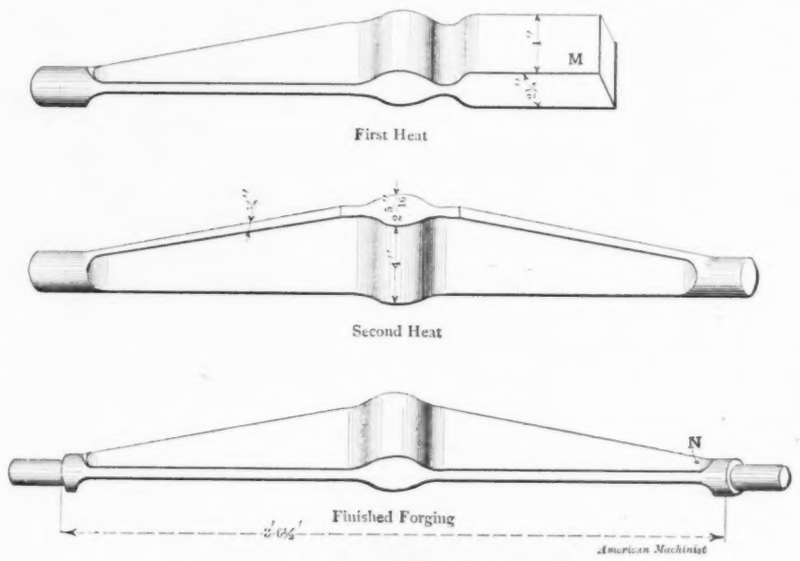


FIG. 1. THE WORK TO BE DONE.

The part *A* of the die for forming the eye and the inclined surface *C* were such that when the faces *B* came together the eye was brought to size and the rake or taper of the beam determined at the smallest section. The second operation under the same dies gave the beam the form shown in second heat, Fig. 1, but entailed less work, as the eye was already formed, leaving the body of the metal (as shown at *M* in first heat) only to be drawn out and shaped as shown.

The ends of the beam, as shown in the illustration of the finished forging, were formed in the dies shown in Fig. 3, which

were fixed in a 300-pound steam hammer, one heat being required for each end. The fillet marked *N* on finished forging, Fig. 1, is formed by that part of the dies indicated at *D*, the correct length of the beam being determined by the location of this fillet, a gage being used to fix the same. The swages at *E* reduce the end to size, both the shoulder and the journal being formed at one operation. The inclined surface at *F*, on the bottom half of the die only, adjusts any irregularity on the edge of the beam caused by the forming of the end.

The finished forging weighs 40 pounds and can easily be produced for 1 cent per pound in the forge. The dies were of tool steel, not hardened, and they produced over 4,000 forgings before being refaced. A set of the dies, shown in Fig. 2, were made from steel castings and gave good results.

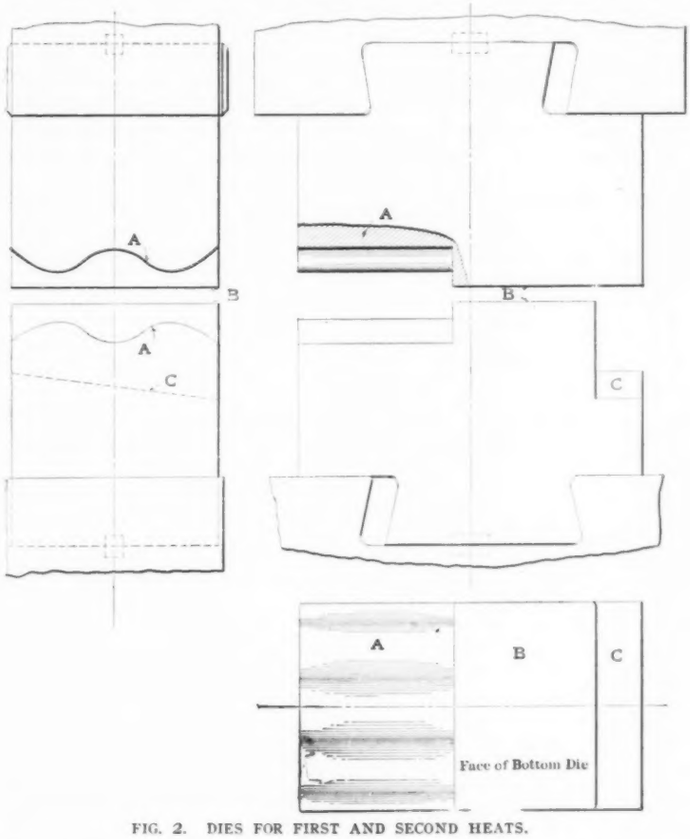


FIG. 2. DIES FOR FIRST AND SECOND HEATS.

Formerly these brake beams were made without any of these fixtures, ordinary spring swages, somewhat similar to those shown at page 684, Vol. 28, being used. A great deal depended upon the skill of the smith who made them and also on the time taken by him in producing them. Some smiths could form the eye only in the first heat, while one smith I knew, utilizing an 800-pound steam hammer with two helpers to heat the blanks and handle the swages, produced a state of finish similar to that shown under first heat, Fig. 1, in one operation. A very ordinary smith, after a little practice, could produce the forging with the dies shown, both the forging and the time taken being satisfactory.

The hammer used was a Massey 800-pound pneumatic manufactured in England, the air mechanism being driven by a 20-horse-power induction motor. Two smiths worked alternately—that is, when one had completed an operation, the other began his, so that the hammer worked continuously, or nearly so. The operation occupied about 4½ minutes. The peak load, as shown by a wattmeter, was caused by the stamping out of the eye, which was always the first part of the operation to be performed. It took the full capacity of the machine to forge this piece, considerable overload being carried during the first blows, and for the type and capacity of this hammer the forging operation illustrated was about the limit.

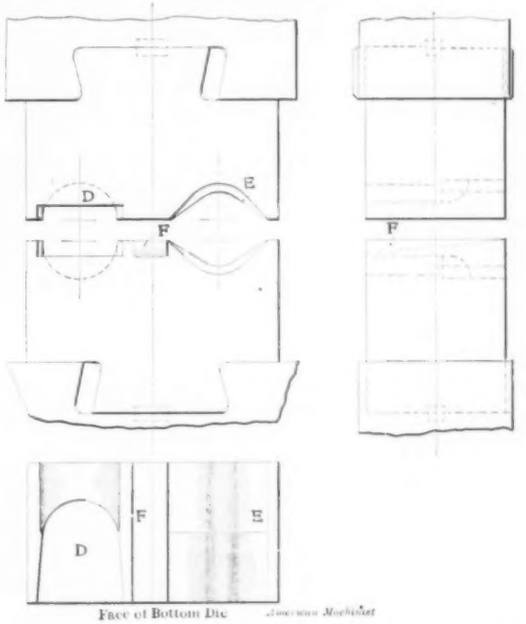


FIG. 3. DIES FOR FORMING ENDS OF BRAKE BEAM.

The Pittsburg Steel Foundry at Glassport, Pa., is turning out some of the largest steel ingots ever produced, several weighing from 85,000 to 90,000 pounds having been shipped recently. They are used for the main shafts for the largest warships.

A German statistician says the English language has 260,000 words; the German, 80,000; Italian, 75,000; French, 30,000; Turkish, 22,500; Spanish, 20,000.

In Dumfriesshire the Scotch pint equals 4 imperial pints.

Letters to the Editor.

Some Shop Comments.

The mean little rules of a shop are what hurt a man; there is also such a thing as too much system or red tape. A fellow went to work as a lathe hand in a shop with a system, where a great number of good machine tools were built. He was given a lot of small pieces to finish and a premium card with the job telling him the time was 19 6-10 minutes each. He stayed half a day; the work, he said, might have been done in that time after a fellow had became familiar with it, but the 6-10 minute and the way the other fellows kept their noses down on the tool caused him to think of a place with less system.

There is always a job for you in this shop. System is all right, but it seems selfish to have it all for the boss and none for the men. Every man is supposed to be on time ready to work a given number of hours per day. He is allowed certain time for dinner, etc. At quitting time, when the whistle blows, he is through serving his employer until it blows again to start work, but now he must in fact fall in line and take his own time to ring up the time clock. A few minutes lost may cause him a hard run to get home for dinner and back in time for the first whistle and ring up again. A number of items might be mentioned, any one of them small things in

themselves, but altogether enough to hurt a machinist.

In one large shop the men are asked to travel from the fourth floor to the street door to ring up at 12 o'clock; if they have their dinner upstairs they are of course compelled to make another round trip. At ringing up time there is always a crowd around and a scramble for the clock, and occasionally a scrap. On pay-day it was customary for a long line to form and generally a wait was necessary for the paymaster to come. Any fellow in a hurry to get a train or get away on business could get his pay the next day if he did not wish to wait from ten to thirty minutes. In this shop if the engine was stopped for a few minutes, why then the whistle was blown those few minutes later at quitting time, and men at the bench, who had lost no time, were allowed to work along unless they had independence enough to quit when their time was up. If the engine was stopped for ten minutes or more all machine hands were docked for that time good and full; the firm never paid out any pennies, so if you lost 2 cents worth of time it cost you a loaf of bread (5 cents). On 400 or more men the firm was making quite a steal in a year.

This shop had no washroom or lockers, and the men hung their clothes on nails in the wall and had buckets under the bench. It cost too much to have a boy carry hot water in the winter for the men to wash in. This shop is so hot in summer and so cold and poorly heated in winter that I have seen the men go home several times to get warm. The city water in this place is next to the worst —often muddy and warm—and this same firm never thinks of furnishing the men good water, but compels them to buy their own ice and water coolers, and if the helper is not too busy the water will be fixed before the ice is half gone.

Orders in a rush are given to the foreman written in red ink, and when I left there a few years ago a foreman's desk looked like a Russian battlefield. The head of this firm bragged among other employers about how cheap he held men, 22 cents an hour being his limit; he is now, I understand, offering 30 cents to good men and having trouble to get them at that.

In some other shops in the same city the men are furnished free, nice filtered ice-water, a nice clean washroom with separate drips of clean water for each man, hot water and a nice warm shop in winter, well lighted and as cool as possible in summer. There are several time clocks to save time and crowding, and the men are not held to ring up at noon. Their pay is brought around to them on Saturday (a day they have time to do shopping), and they are not charged or compelled to make up any stoppage of the engine while they remain in the shop under orders.

There are a number of little things an employer can do to please the men that will cost him little, and I think it pays better to have men hum and whistle than to have them surly, with a lot of little things to kick about. Enough time clocks should be placed convenient to avoid crowding, and as for ringing out and in at noon I don't think a man taking his lunch in the shop should be held to do so. A man is bound to ring out on leaving the shop at evening in order to register his day's time, and there must be some one in the shop to know the men have started to work, even if they have registered on the clock. I may be put down by some as a kicker, so I will add that I am in a preferred shop and have no complaint, but I don't think an honest man has any right to dock an employee as long as he is in the shop subject to orders. And good water is I think as important as a man's food, and should be furnished without cost to the man the same as tools to work with.

YOURITSKY.

Armature Winding.

Few people who have an electric fan in their office or home stop to think what an immense amount of ingenuity is worked up in its development. When the fans were first put on the market they sold I think as high as $35 (and were very crude at that); now you can buy a first-class one, perfect in every detail, for $10 or $12. This has been all brought about by special tools and appliances. One of the most notable of the special machines is the automatic armature winder. I will not attempt to make a drawing of the machine, but will show only the cardinal feature which is the armature holder and wire guide combined. I show this in Fig. 1, set in a speed lathe, which would make simply a hand machine.

The automatic machine is in reality a semi-automatic; you must have an operator to fix the commutator leads. The machine is a speed lathe geared up so as to make any given number of revolutions and stop automatically for the operator to make the commutator lead and shift the armature to the next slot.

Fig. 2 shows plan and side elevation of the winding chuck with an armature in place. As shown it is for a bi-polar armature. But I think it could be arranged for four-pole machines as well. Hand-wound armatures are usually wound in diametrically opposite slots; of course this could not be done with this chuck, so they skip one slot to get by the shaft. In winding ordinary fan-motor armatures by hand I do not think one could do over two in ten hours; with the semi-automatic the operator winds one every ten minutes.

I think that the drawings are self explanatory to anyone who knows anything about armature construction, so I will not go fully into detail about them. These chucks are made of brass and the guide projections *A* and *B* must be polished. The wire-slot *C* must be close to the size of the wire to be used, so as to skip the armature disks and not rupture the in-

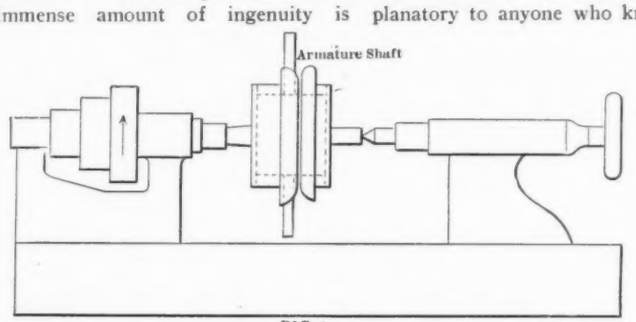


FIG. 1

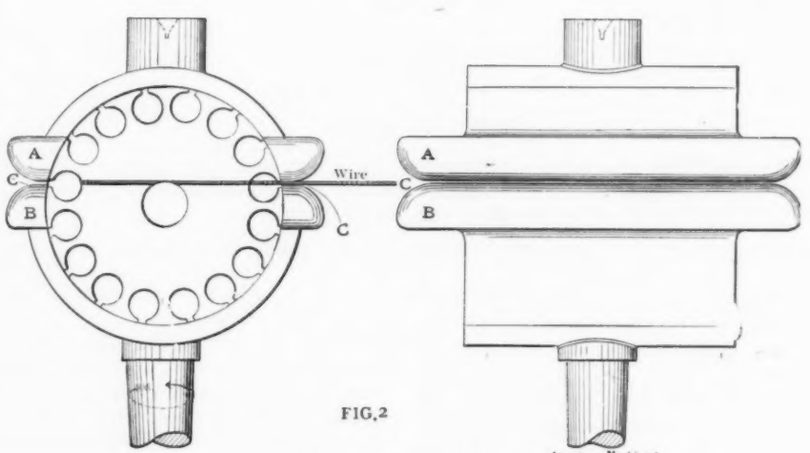


FIG. 2

ARMATURE WINDING CHUCK.

sulation. Any person who has small armatures to wind can make one of these chucks and use it in an ordinary speed lathe with the addition of a counting device which you can buy for a dollar, and which can be operated by a small cam fixed on the lathe spindle. I was building some ¼ horse-power motors. It took ten hours to wind the armature by hand and with this arrangement I could wind one every thirty minutes. In making these chucks it is best to cast in one piece, bore out for the armature size and turn the driving shank, then put on an arbor and saw slot *C* in the milling machine by the index, as it must be parallel with the bore as well as in the right place to coincide with the slots in the armature disks. I never knew who was the inventor of this chuck, but he certainly was a genius. F. C. MASON.

Making an Accurate Index Plate.

The article on making an accurate index plate by Otto Eckett, at page 792, set me to thinking how I would test that plate if I had to inspect it. Theoretically he is correct, but I find in practice that we have to prove the accuracy of work placed in contact with screws as per sketch Fig. 5, page 793; especially when clamped, as shown upon a surface of the index plate that has not been ground. This set me to thinking how he proved that the blocks or lugs *a* and *c* would be parallel with the hole when unclamped before it was too late to remedy the error.

He has given no thickness for the plate, which is one of the important factors considering its diameter—150 millimeters, or 5.9055 inches.

We find it good practice to adopt the ways and means used in producing the work when we inspect it; it cuts down cost and shows the principle used by the workman who does the job. That in itself tells a story for good or bad results.

Piece *A*, Fig. 1, we would grind parallel on both faces, then grind and lap the hole to size and work from the hole and face of the index plate. This would detect the error in the blocks if out of parallel with the hole.

Piece *A*, Fig. 1, is mounted on stud *B*, which is a good fit in *A*. The angle iron has a hole for a loose fit for the end of stud *B*, which is threaded for a nut. The hole under block *d* allows one to see through when adjusting the blocks at right angles; piece *A* is clamped to the angle iron with a strap and screw that enters stud *B*. Angle *C* is gray iron and narrow enough to allow the blocks to extend out from the sides to be ground.

Fig. 2 is composed of a gray-iron block *D* and a piece of finished flat steel *E*, which is 3-16 thick and worked out to the outline of piece *A*, Fig. 1, leaving plenty of space. The ends are beveled, hardened and ground back on face *e* about a quarter of an inch. In lapping this edge, make it rounding, not sharp. Block *D* is finished on three sides;-top, bottom and the face piece *E* is attached to; this allows you to turn it over and prove both sides of the index blocks. The dimension *x*, Figs. 1 and 2, should be close enough to allow the square to be used either side up.

Fig. 3 is the old principle of the reversible parallel for testing a square Parallel *F* swings on stud *G* and is adjusted with the screws shown at the top, which are pivoted to swing out of the way to allow the parallel to be reversed end for end. To test the square you adjust the parallel to the square on one side; let the parallel remain in this position, place the square at the other side of the parallel and it will show twice the error if there is any. To test the parallel, reverse it end for end, then adjust to the square. It should fit the square on both sides of the parallel, or it will show twice the error on one side if not parallel.

With the index plate placed in position on the angle iron, Fig. 1, blocks *a* and *b* are leveled up and have been found to have the least amount to be roughed off; these are ground off. Then the index plate is revolved a quarter turn by using the square in Fig. 3 to square to the surfaces just ground, and *c* and *d* are ground to the same reading of the index wheel on the grinder or to a height gage. Now revolve the index plate another quarter turn using the square again, and at the fourth quarter turn you have gone around all faces of your blocks. Now take a light cut to make up for the wear on the wheel from the roughing cuts, and go around without disturbing the setting of the wheel, and at the third quarter turn you can prove your square and setting with a micrometer. Your last surface should be parallel with the one under it. After going around the second time your blocks are divided equally each side of the center, but are too large. You have found approximately how much your wheel lost in size, by the roughing cuts, so you can rough them down pretty close for the last roughing, leaving just enough to finish with.

This leaves nothing to guess at, the errors can be located and measured, all operations are tested before and after setting and clamping. The square is used on the index plate face as well as on the side of the blocks.

If I found that clamping in the way described distorted the plate I should drill a hole through stud *B*, and use a bolt and nut instead of a cap screw.

SCOTTY.

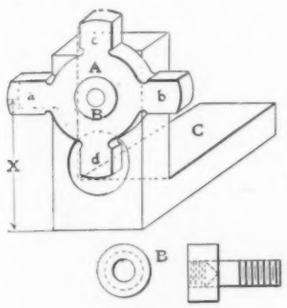


FIG. 1

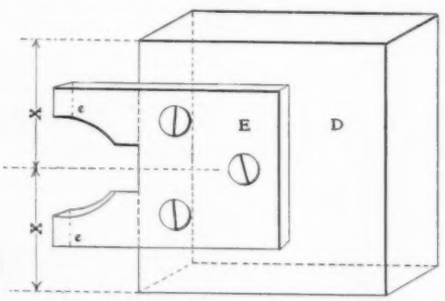


FIG. 2

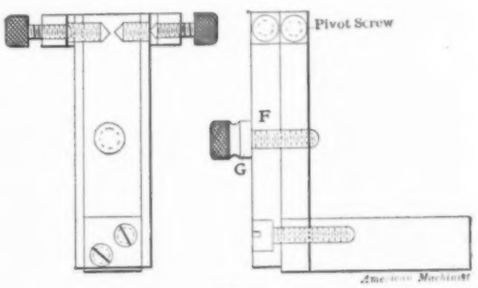


FIG. 3

MAKING AN ACCURATE INDEX PLATE.

A Plea for Larger Pulleys.

The statement, attributed to Edison, that "a machine should be made so that a jackass can run it," has an element of truth in it.

Now I am not prepared to admit that all wood-workers are jackasses, for I'm one myself—that is—I mean, I'm a wood-worker; but it must be admitted that there are certain of our fraternity who don't understand how to get the full quota of work out of a belt. This shortcoming, however, is far from accounting for all the slippage of belts on our machines.

The conditions of a wood-working shop make it practically impossible to get quite as good results as are attainable in machine-shop practice, as the dry atmosphere has a tendency to keep the belt dry, stiff and harsh; and any known belt dressing, even if applied with discretion (which, by the way, is a very essential flux for belt dressing) has a tendency to collect the fine dust with which the air is always laden.

I have seen a belt to which dressing had been applied (without the aforementioned flux, be it said) so laden with "gurry" that it pulled twice as much when turned the other side out; while another, which was near a sanding machine, and

on which no dressing had been used, slid around the pulley like "greased lightning" and hardly pulled a pound. Of course these were extreme cases, but the fact remains that the dry atmosphere, with its burden of fine, smooth dust, makes it impossible to keep a belt in proper form for the best results.

Another consideration is the matter of speed. Of course we all know that, up to a certain limit, a belt gives better results at a higher speed; but this speed limit is very difficult, perhaps impossible of determination, dependent, as it is, on the size of the pulleys. A belt running at a given speed, over two large pulleys, may transmit a certain power; but, reduce the size of one of those pulleys and maintain the same belt speed, and the amount of power transmitted may be very much reduced, owing to the reduction of the belt contact by the difference in size of the pulleys, and to the fact that the centrifugal force acting on the belt tends to still further reduce that contact.

It is presumed that machinists generally make their pulleys of the proper size to give the required power, under theoretical conditions, and doubtless they allow some margin for worse conditions; but I hold that, on wood-working machines especially, they do not, as a rule, make this allowance large enough. Nor are wood-workers alone in their trouble, for only to-day the operator of a flouring mill remarked to me, "I haven't a pulley in my mill which is as large as it ought to be"; which remark was provoked by observing the action of a pump recently installed, whereon the belt slipped when the stuffing boxes were tightened the least bit too much.

A little surplus power is an excellent thing, pleasing to all men; lengthening the life of man and machine, and in all ways fitting; but the lack of a little is a condition trying to the patience and in all ways cussed.

Please, Mr. Machinist, give us larger pulleys. W. D. GRAVES.

Country Shops—Some Workmen's Houses.

I very decidedly believe that the half dozen largest cities of the United States and many other cities not so large, are among the worst places in which to operate machine shops and kindred industrial establishments. There is really nothing to recommend such locations from the commercial or financial view-point, and in every other way the greatest good of the greatest number is best promoted by locating in the smaller and isolated country towns.

Many shop proprietors are coming to realize this, and we hear frequently of the removal of shops to or the rebuilding of them in places outside of and often distant from the large cities where they have had their preliminary growth. These changes of mere location, however, are not always as successful and satisfactory as anticipated. I find that there is a vast difference between the business which has been removed from the city to the country and the one that has had its long period of natural growth entirely in the country town.

The problem of personnel applies here as elsewhere. You cannot have good, willing, helpful men all through the shop without having "white" men in the office, even into the sanctum sanctorum. It makes all the difference in the world about the mental equipment and attitude of the proprietors and managers of the country shops as of shops elsewhere. We have had more than a few warnings in the correspondence columns of the AMERICAN MACHINIST against being landed and stranded in the "one-shop town." There are places, we know, where the idea is to squeeze the men in every possible way, to take advantage of their circumstances, to circumscribe their independence, to adjust their wages, not according to their earnings, but according to their ability to enforce their rights by change of location when necessary. There is nothing so necessary in some places as to keep up a constant bluff of independence. To own a house and to be at the same time in the employ of one of these firms is a double misfortune.

There are shops in some towns, however, very different from this, where mutual respect and helpfulness rule, and among these shops are some which have prospered and grown and which hold to-day national reputations and have high business standing. It would be invidious to specify, but I have several such concerns in mind. The men in the shops I am thinking of are almost entirely the product of the country immediately surrounding. They have not caught the fever and unrest of the city. They know the home life and can appreciate and engage in the placid occupations of the quiet hours. Their lives are worth more to them and their skill and diligence are worth none the less to the business with which they are connected and to the world at large than if they dwelt in hot and crowded tenements and were the slaves of the trolley-car, nickel-in-the-slot, ice-cream soda, unlimited beer and the rest of it.

I am poked up to talk in this way from having recently, in my summer wanderings, seen one of these country shops with, as it seemed to me, very near the real country-shop atmosphere. The shop

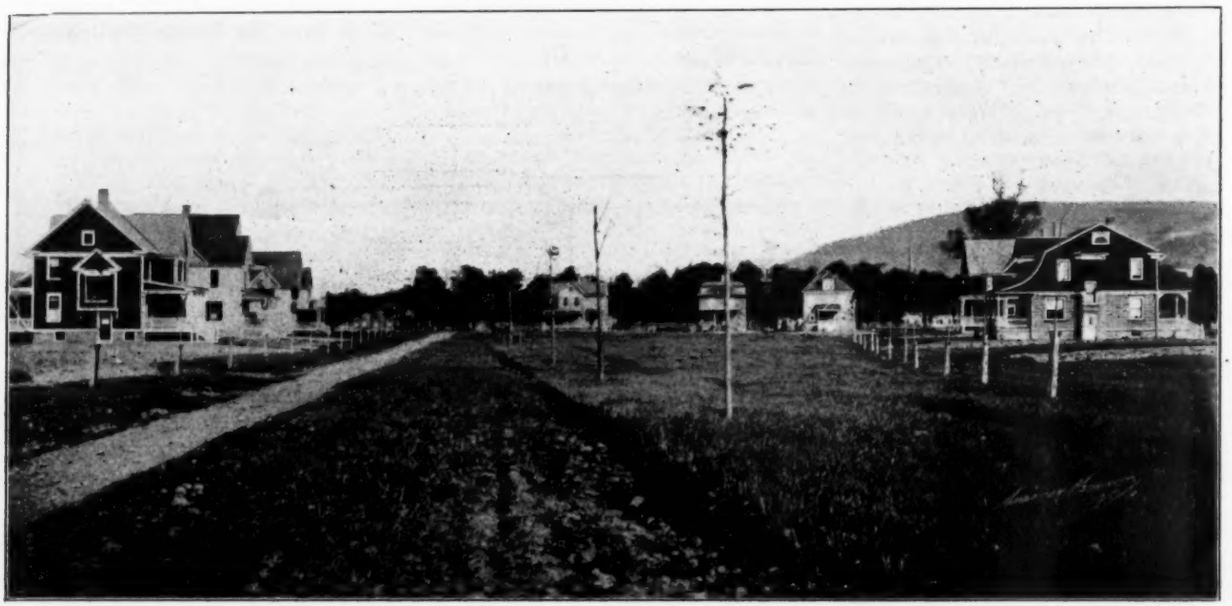


FIG. I. WORKMEN'S HOMES AT PAINTED POST, NEW YORK.

I speak of is at Painted Post, N. Y., one of the shops of the Rand Drill Company, in which some three hundred men are busily engaged in the building of small or medium-sized air compressors. This is an old shop, as shops go in this country. More than fifty years ago it was a small shop, doing general work and building slide-valve engines. Later it was the Weston Engine Works, then the Imperial Engine Works, and for several years the Imperial type of air compressor has been built here for the Rand Company.

The men of the shop are mostly those who have grown up right in the neighborhood, and the large number of young men in the shops are mostly farmers' boys. F. W. Parsons, the general manager of the Rand shops, Mr. Hollister, the superintendent of the local shop, Mr. Pitts, chief draftsman, and others in leading positions have been interested in these men and are working with and for them not only as workmen, but as fellows wanting to get the general good of their lives. The young men are encouraged to learn and to know things, and they read and study. Many of them are students of the correspondence schools. A recreation house has been provided in a bank building in the village which is open nights and all day Sundays and is appreciated and largely enjoyed by the men. The leading technical journals are kept on file and a large selection of magazines of general literature. There is also a considerable general library and various games and means of recreation.

The heads of the company are as far as can be from being temperance fanatics,

FIG. 2. WORKMAN'S HOUSE AT PAINTED POST.

but they could not ignore the fact that the saloon was too prominent in the village and was too enticing to many of the young men, and so they went into local politics and worked strenuously and persistently, holding meetings, making speeches and stirring up public sentiment so thoroughly throughout the town, which is a large one, that it is now a no-license town, the sentiment being so pronounced that even the drug stores refused to avail themselves of the liquor-dispensing privilege.

The half-tone tells of another scheme of practical help that has been gone into. A triangular piece of land has been secured about five minutes' walk from the

FIG. 3. TWO HOMES.

works and divided into building lots for the men to buy and build on. The soil is excellent, the location, near a river, has made drainage easy and a good water supply is provided. There are 127 building lots, the smallest of which are 50 by 120 feet (the New York city full lot is 25 by 100 feet, though many lots are 20 feet wide or even less). The largest lots are not more than double the size of the smallest. There is one corner lot valued at $225 and one lot at $200, the others ranging lower in price down to $100, at least one-half of the lots being under $150.

The men can begin making payments on lots selected according to their means, and when the lot is paid for a building and loan association will advance money to go on with the building, the continued payments finally leaving the house free. There are necessary restrictions as to the character of the designs to be adopted, and the half-tone shows for itself what the houses are. They are intended to be homes, every house being for a single family, with none of the doubling-up that is too prevalent in cheap-house schemes Only a portion of the houses are shown in Fig. 1, other typical ones appearing in Figs 2 and 3. There is a great variety of tasteful designs, no two seeming to be alike. Striking effects are secured with concrete building blocks, as in the house at the right in Fig. 1 and the farther house in Fig. 3. There are no fences, and when the trees are grown and the gardens under way a much prettier scene will be presented. The layout leaves two triangles of considerable size, forming little parks belonging to the entire community. This settlement is not isolated, but immediately adjoins the present residential portion of the village, with a large and excellent public school near. I like to see such things as these going on, and I am glad to have the opportunity of bringing this particular case to the attention of the readers of the AMERICAN MACHINIST.

TECUMSEH SWIFT.

A Youthful Inventor of a Wheel Washing Machine.

The washing machine for buffing-wheels shown by H. A. Dudgeon at page 124 is so nearly identical with one designed by myself many years ago, that the picture calls up some memories.

When a small boy (not yet in my "teens"), I sought and obtained employment in an old Connecticut "hame" factory. I had visions of wealth that I would gain from my industry, and entered the employ of an old-time contractor, who, among other things, did the polishing of the metal work on hames. He used wood wheels covered with leather and coated with glue and emery. A large part of my work was to "wash" or soak off the glue and emery from the worn wheels preparatory to the re-coating.

I wish it were possible to show a photograph of the place and the facilities—a low, dark cellar, among rats and mice, where never a ray of sunlight entered. A small leak in the old water-wheel flume furnished the water supply. I had to hold the wheels and so turn them that gradually the coating of glue and emery was soaked away. It was a tedious and ambition-killing process for a boy—holding *one* wheel at a time and slowly turning it to bring all parts of the circumference under the stream. I remember that it required an entire day to wash a very few, and many days were required for the whole lot. I can recall how injured were my feelings when I believed I was competent to perform the skillful mechanical work up in the shop above, and how I planned various protests, the language of which I readjusted from hour to hour that it might be convincing when the auspicious moment for its utterance should arrive.

At last the injustice of my treatment became so great in my mind, and the foolishness and wastefulness of such labor so plain to me, that the invention of a machine for doing the soaking automatically rose uppermost in my mind, until I forgot my eloquent protest and fell to studying out the great invention. I forgot all about the darkness and loneliness of my workshop, and all about the fact that I was slowly turning in my hands the wheel that was soaking. I forgot that my

clothes were wet and cold from the water that missed the wheel and soaked me. All this was forgotten in the mental visions of the machine that was to wash a dozen or more wheels in the same time I was washing one, and was to do this while I was employed at more useful and more interesting work above.

At last, when my vision was complete, I summoned up my courage to explain it all to my employer, full of hope and visions of progress. Alas! I did not know that I was then to learn my first lesson in opposition to progress. My employer laughed, and several others with him. The impossibility of washing a dozen wheels at once and without labor was too clear to them to admit of a doubt. Little did I realize then that this opposition was only the beginning of what my life should encounter in the introduction of new designs and processes. Little did I then understand that all progress must be made in the face of opposition from those who, it would be natural to suppose, would be more interested in it.

I then also learned my first lesson in false economics. I was informed that if such a machine could be made to work, I would be out of a job. I replied that I could be employed at some of the work in the shop more interesting. I was informed that there would then be no work for others. They were too much for me then, but I could not get over the belief that, with the washing machine in operation, I could be more profitable and my work more interesting. I was crestfallen, my great invention turned down by my employer and I laughed at. I stole away quietly and waded in the pool under the waterwheel that was then still for the noon hour.

There were some bright, shining fish darting about, and it was easy to catch them with the hands, as the stopping of the wheel had locked them in the pool, owing to the lowering of the water connecting with the outer stream. My grief was somewhat healed by the easy catch of fish to carry home at night to my mother, and I pictured her interest in my possession when I should hold my string of fish proudly out as I came in.

My mother! Who never laughed at my inventions and plans, but who assisted me to build waterwheels and engines of shingles and tin spice boxes; who did not scold me when grandmother's sacred "skunk's oil" was missed because I had used it to oil my lathe in the barn. To her I unfolded my plans for a wheel-washer and told her of the attitude of my employer toward my invention. It was she who encouraged me to keep on with my study; it was she who assured me that sometime not far distant I would see my invention realized.

Time and change have wrought their wonders since then. "The old hame shop" is gone. A fire destroyed it years after, and the place where I worked, alone in the darkness, is now uncovered to the sunlight and the wild flowers bloom there. My mother has gone, leaving the bright memories of her kindly life and helpfulness; and her assurance that some day my wheel-washing machine would be a reality has proved true, although many years after she had gone. A machine almost identical with the one illustrated was made, and so far as I know may be in use to-day.

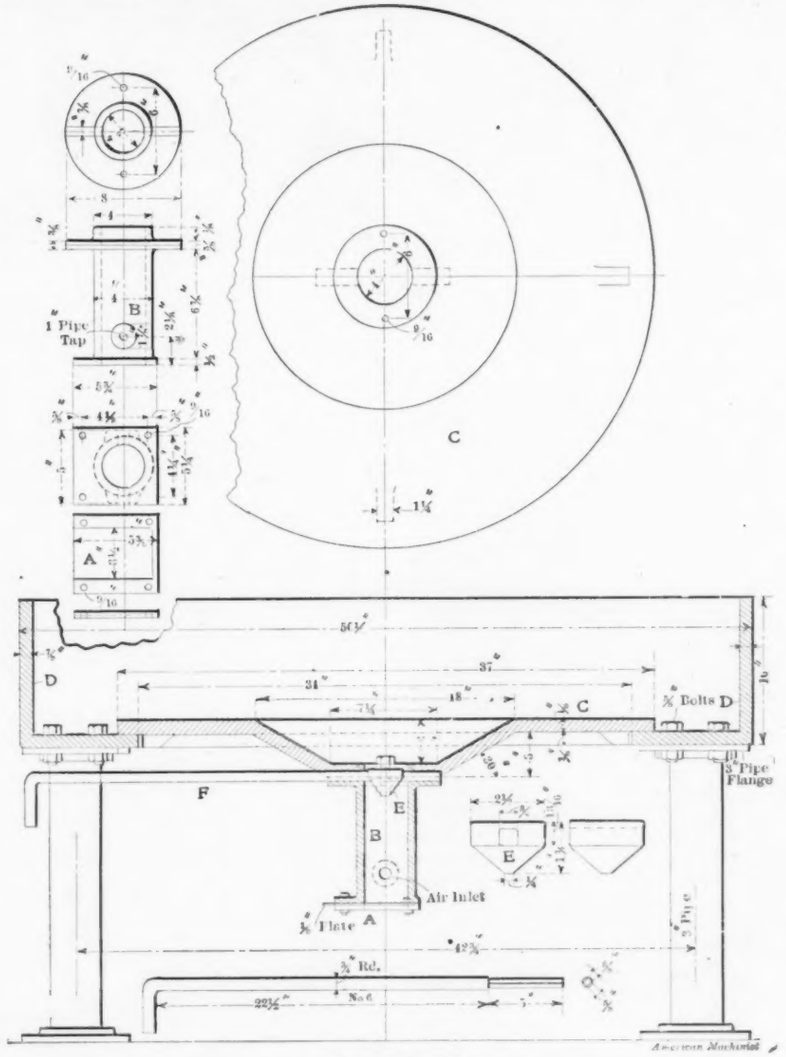
I am sure that no boy to-day is washing wheels by hand, but that some machine does this work while the boy is better employed.

C. H. MORTON.

Worcester, Mass.

A Portable Forge.

I send you a drawing, with the principal dimensions, of a forge that has proved very convenient and which I thought might be interesting to the readers of the AMERICAN MACHINIST. The bed *D* and bottom plate *C* of the forge are swept up and made of gray iron, no patterns having been made for them. There are four legs, made of 3-inch pipe, bolted to the bed casting with ⅝-inch bolts. The center piece of tuyere is bolted to *C* with ½-inch bolts.



A PORTABLE FORGE.

The small conical casting *E* is driven on to the square end of the rod *F*.

There is nothing about this forge that is apt to give any trouble. One thing very convenient about it is that it can be placed anywhere, and all the changing necessary is in the air connection. If the fire gets full of clinkers these can be dropped out at the bottom without having to tear up the fire very much. The bed of the forge is filled up with firebricks set on end. This forge has been in use for several years, and has proved very satisfactory.

HERBERT S. GLADFELTER.

Desloge, Mo.

Another Loose Pulley Core.

A good many of the contributors are having a word about loose pulleys. I have one to submit—a 10-inch pulley running 450 revolutions per minute, and since being fixed as described it has been running for years with very little care and attention. A pattern was made for a bronze bushing with a flange at one end having a boss for oil cup, and opposite

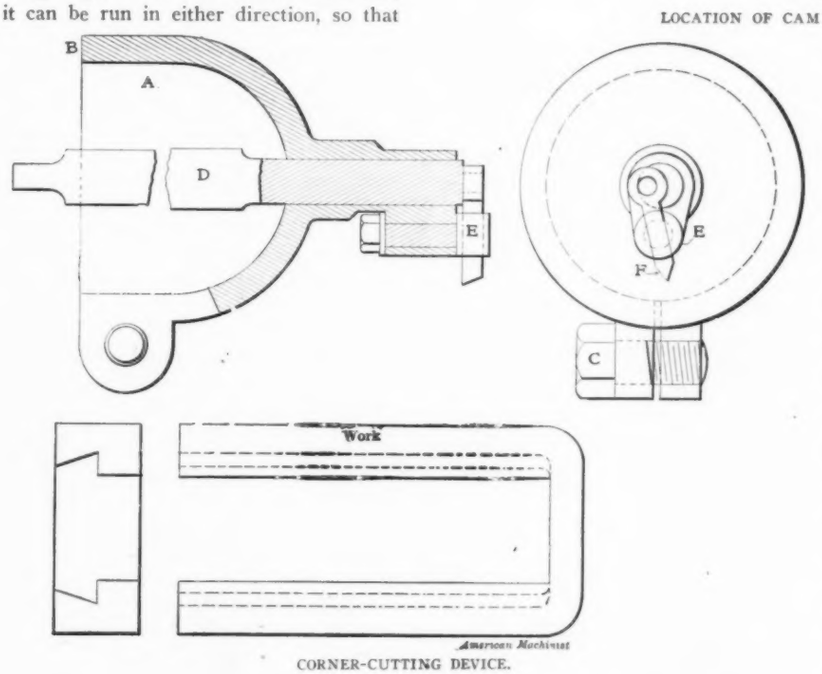
the boss a projection to take a ½x2-inch wrought iron support bolted to the floor. The pulley was rebored to allow about ½- to 5/8-inch stock in the bushing. The oil feeds directly down on the shaft, and by grooves chipped on the inside of the bushing is led so that part of it runs through holes to the outside of the bush. When the machine is idle this oil provides ample lubrication for the loose pulley and when the machine is running the loose pulley will invariably stop.

PEARL RIVER.

Corner-Cutting Device.

The blueprint shows a device or attachment for use on milling machines. By the use of this attachment, work may be easily machined, which would perhaps otherwise be accessible by either hand or machine.

The body *A* is fitted to the vertical head of the milling machine, which is turned to receive it. The flat surface of the top edge *B* is graduated to 5-degree divisions, there being a zero mark on the vertical head. The device may be set to any desired angle and held by clamp screw *C*. Underscoring, recessing and the finishing of ends of T-slots or dove-tails of any angle can be easily and rapidly done, the cutting tool being shaped to suit the work. It is especially useful on work of the character shown, which may be held in a vise, the tool being set at an angle of 45 degrees with the corner to cut out; it can be run in either direction, so that



CORNER-CUTTING DEVICE.

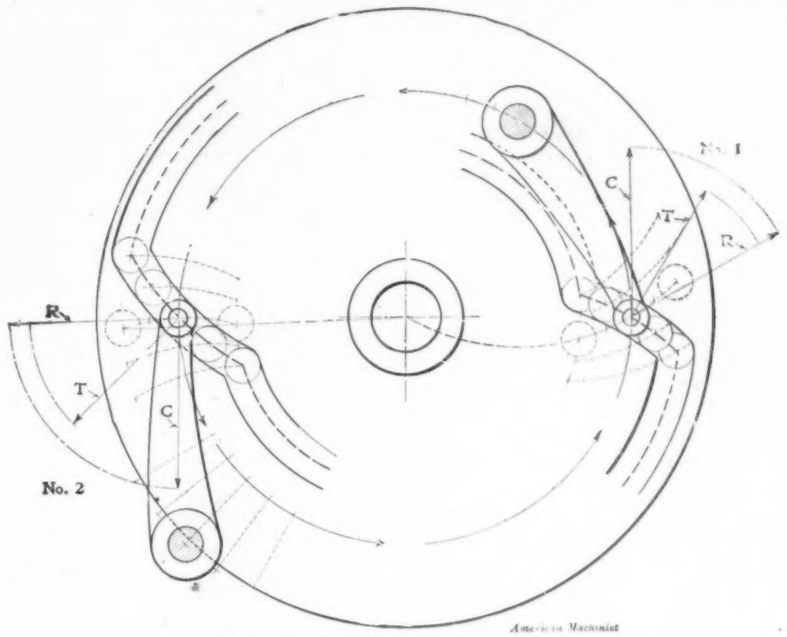
at all times the tool will be cutting against, and not with the feed. Spindle *D* may be made with a disk carrying an adjustable crank; also by varying the position of fulcrum *E* and the length of tool *F* any radius may be cut.

Corners of any desired radius may be cut in close or difficult places with this tool; it has also been used for cutting odd and geometric shapes. The tool is not expensive, and it will be found useful in plenty of places where special and costly mills would probably fail to do the works.

U. B. SHURE.

Location of Cam Levers and Cams.

Differences of opinion exist among your contributors anent the corrent location of a cam runner which moves in an arc of a circle and is operated by a face cam; which differences seem to be principally due to the assumption of non-uniform governing factors. The accompanying illustration shows arrangements numbered 1 and 2, each of which has supporters, all of whom may be correct from their own point of view.



LOCATION OF CAM LEVERS AND CAMS.

Cam levers of like lengths, having like degrees of angular motion imparted in given timed relation from cams of like diameters, occupying the relative positions 1 and 2, each possess advantages within their respective spheres. The main factor governing their relative efficiency is the duty the lever has to perform, for instance, under two different sets of conditions—first, that of moving a lever against a resistance heavier in the one direction than in the other; second, that of moving a lever to and fro against a constant resistance.

For dealing with the first set of conditions, position No. 1 would be the most favorable, because the mean direction of traverse *C* of the cam more nearly coincides with the direction of traverse *R* of the runner, whereby the length of the acting cam face necessary to give the required motion, together with the relative motion of the frictional surfaces, is reduced; and, further, because the line of thrust *T* of the cam face also more nearly coincides with the direction of traverse *R* of the runner, whereby the working pressures are lessened.

For dealing with a constant resistance position No. 2 is a more correct one, because, with the resistance of the lever to motion equal in either directions, the thrusts and direction of motion of the cam should be equally favorable to traversing the runner either inwardly or outwardly, and this is more nearly the case than it is in position No. 1, in which it is obvious that while the thrust and direction of motion of the cam would be more favorable to the motion of the runner in the outward direction, it would be much more favorable to its return movement.

In the case of the resistance to traverse of the runner being in the direction of motion inward, the relative positions of cam and lever would require to be altered to a still further degree from position No. 1, to give the best result.

EX-DRAFTSMAN.

Dimensions on Drawings.

A good deal has been said and written about drawings being fully dimensioned and no doubt there will be a great deal more said for or against it. Some claim that it is not necessary, and others that there cannot be too many dimensions on a drawing. Put me down as of the last-mentioned class.

Time is saved by the draftsman when he does not stop to put all the dimensions on his drawings, but the pattern-maker loses this time in scaling the drawings and looking the draftsman up when he is in doubt about the result obtained, and does not wish to assume responsibility. Some concerns have the draftsman put machinist's dimensions only on the drawings and leave it to the pattern-maker to scale the drawings entirely when making the pattern. This takes the pattern-maker's, the foreman's and the draftsman's time to explain to the pattern-maker the different dimensions wanted, and if there is an assembly drawing it will take more time to study out that assembly than it does to put on all the figures.

Consider the drawing of a large object that has been made to a small scale. The drawing is made and the atmosphere gets in its fine work of stretching the paper. How easy it is, then, to gain a sixteenth, an eighth, or even a quarter of an inch on a long line where the object is drawn to as small a scale as ⅛ inch to the foot. How is one to know if the figure wanted comes into eighths, sixteenths, or thirty-seconds, if it is not down in black and white? How much trouble is the pattern-maker going to run into when he attempts to scale a drawing of this kind, when a question of clearance is concerned? How much time is he going to loose out of the time the draftsman saved in not putting down all of the dimensions?

Then, again, if it is necessary to re-draw an object, the drawings must be scaled by the draftsman, and he loses all the time scaling it that he gained by not putting the dimensions on, and if two or three different men have been working on the same thing at different times the drawing will probably differ from the original.

HENRY A. FALARDEAU.

Worcester, Mass.

Peculiar Effect of Sea Water on Gray Iron.

Referring to Dixie's letter at page 63, Vol. XXVIII, Part II, will say that the action on gray iron is not confined to sea water. I have noted the same thing on all parts of the pumps coming in contact with the water here. The action is much greater on the air and feed pumps where the water is warm. Steel and wrought iron are simply eaten away, one ¾-inch stud having been reduced to 5-16 inch in 8 years. In contact with boiler water, temperature due to 60 pounds pressure, it is not affected, as hand-hole plates are apparently sound. The water is almost absolutely pure, resembling rain water. I will send you a sample of the iron.

J. F. BRADLEY.

Valparaiso, Ind.

[The sample bears out what was stated in Dixie's article.—ED.]

How He Bushed the Screw.

I had one of those genuine country boys come to work for me lately. He was right off the farm, with the hayseed in his hair and onions in his ears. It isn't often you get hold of them nowadays, but when you do they are all right.

I started him to work on an old punch that was somewhat the worse for wear. The screw holding the punch shank was "wabbly," but I was trying to run it until I could get a chance to have a new one made.

Having occasion to go to the press the next day after he started, I found the screw was apparently in good condition; the "wabble" was all taken out of it, and it held the punch in good shape, and still it was the same screw. A close inspection showed me that there was a copper liner extending two-thirds of the way around the hole and clear to the bottom of the same. "Hello! who did this?" I exclaimed. "Oh, I did," said "Country." "Yes, but who told you how to put it in?" "Why, no one, sir; only when the mowing machine bolts used to get shaky we had an old coffee pot, and I used to cut strips of copper off of it and put them inside the nut and screw them on to the bolt, and it would hold them fine, and I thought, perhaps, it would work the same here. Hain't it all right?" "Yes, my lad, it is all right," I replied, and passed along.

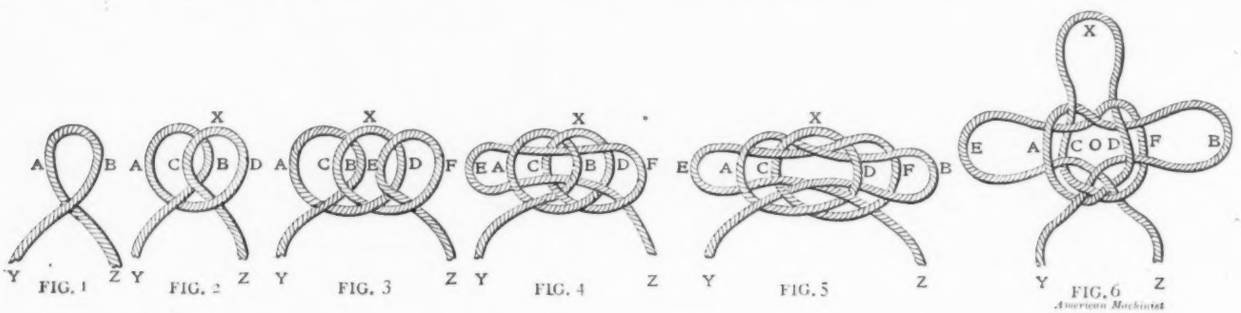
"Country" is still sawing lots of wood, and, if I am not mistaken, your readers will hear of him again later on.

A. P. PRESS.

A Mast-Head Knot for Temporary Derricks, Etc.

The knot shown completed at Fig. 6 is also known as "jurymast knot" and "bottle hitch." It can be used in place of a "mast iron" at the top of a derrick to make the guys fast to.

Although at first glance it appears to be complicated, it is very easy to make.



A MAST-HEAD KNOT.

Take a piece of stout cord and hold it between the thumb and forefinger of each hand with a space of about 6 inches between the hands. Then twist the cord *right-handed* with the thumb and forefinger of the right hand only. This will throw up a "bight" like Fig. 1, with the part *A* under *B*. Grasp the loop thus formed between the thumb and forefinger of the left hand at the point where the two parts cross. Then move the thumb and forefinger of the right hand along the cord about 6 inches, and throw up another "bight," laying it on top of the first one. You then have Fig. 2. Hold these two bights with the left thumb and forefinger, measure off another 6 inches and throw the last "bight." Place it on top of the last one made and you have Fig. 3. Take the part *E* in the last bight at Fig. 3 and—while holding the other parts in place—pass it under *B*, over *C* and under *A*. This makes Fig. 4. Then take *B*, Fig. 4, and pass it under *D* and over *F*. The result is Fig. 5. Then, while holding *E* in the left and B in the right hand, take hold of *X* with the teeth and pull it. The result will be Fig. 6. In practice the part *O* in Fig. 6 goes over the reduced part at the mast or derrick head.

The forestay is made fast to *X*. The stays to *E* and *B*. *Y* and *Z* form the back stays. Any strain on the stays tightens up *O*. By pulling *Y* and *Z* in opposite directions the knot comes out.

DIXIE.

How Gun Barrels are Straightened.

Under the above heading an article appeared at page 44, which will be of interest to all lovers of the gun; and it might be of some importance to know how the barrels of a double-barrel shotgun may be straightened, if by chance they are bent by accident or through error in putting together, either one of which may and does often happen.

Mr. Avis has neglected to mention, in describing the straightening tools, one that has proved to be quite essential. Begging his pardon for "butting in" and with his permission I will attempt to describe the tools for straightening barrels after they have been coupled in pairs —with the ribs off. Referring to the accompanying sketches, Fig. 1 is to be held by a helper, placing one of the prongs between the barrels while they rest as

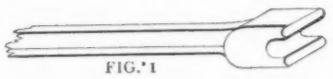


FIG. 1

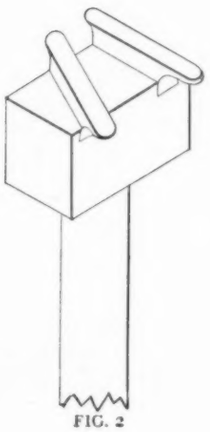


FIG. 2

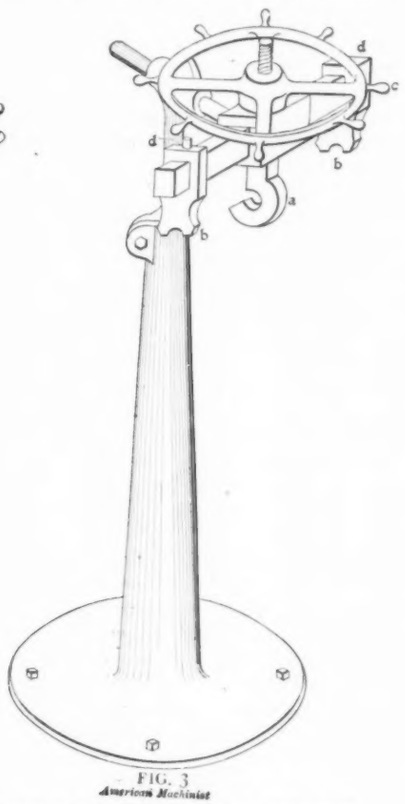


FIG. 3

American Machinist

GUN BARREL STRAIGHTENING TOOLS AND A STRAIGHTENING MACHINE.

usual on the dies. The upper prong is struck by the straightener, hence either barrel may be straightened without bending the other. If the barrels appear to be bent in toward each other at the ends it will be necessary to use a block like Fig. 2, with projections on the ends of the dies as shown, the barrel being struck by the hammer alone in the ordinary way.

Mention might be made also at this time of a machine for straightening barrels—not to praise or condemn, but to simply state our experience, letting others judge for themselves.

The machine shown in Fig. 3 was bought by the company, where I am located, expecting that cheap and inexperienced laborers could turn out work equal to the best. Perhaps it is more successful in Belgium—that is where the machine was made. Experience is certainly as important in its operation as with the hammer and block, and then only about one-half as much work can be turned out by our best men.

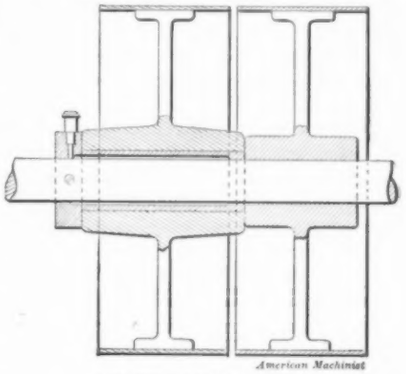
The barrel is placed in hook *a* and directly under dies *b*, which are provided with changeable brasses. When the crook is located by noting the shadow lines inside the barrel in the ordinary way, the hook is raised by turning hand-wheel *c*, the hub of which is provided with a quadruple thread to fit the upper end of *a*. The parts are adjustable to accommodate the height of the operator, hence it is possible to watch the process as the crook is squeezed out. Block *b* may be adjusted by loosening set-screws *d* for short crooks. Needless to say this machine has not been used since its first thorough trial about two years ago. So I say let each one judge carefully for himself before buying any machine for straightening gun barrels.

One other method is quite handy for doubles with ribs on, when both barrels are bent in the same direction; that is, by grasping the barrels in both hands an equal distance above the bend and rapping the muzzle on a block of wood, but experience is always necessary.

E. PIERCE.

The Loose-Pulley Nuisance.

I inclose herewith a sketch showing another method of overcoming the loose-pulley nuisance. The bush is made of phosphor bronze, preferably, although I have known a gray-iron one to behave



ANOTHER LOOSE PULLEY.

very well. The hole is bored out in the bush, as shown, to form an oil reservoir, and grub-screws are provided to prevent the bush from turning on the shaft. This arrangement I have found is very satisfactory, giving a quiet and clean running loose pulley.

YORKSHIRE.

England.

Confusion of Words and Signs.

Language is supposed to enable people to convey knowledge, and it should serve that purpose. There is, however, considerable lack of uniformity in the meanings of words and expressions, even in the United States.

I was in a railroad shop and was told to pack a stuffing box. I asked if I should make a gasket, and if so, what kind. This brought up the question, "What is a gasket?" The railroad man said it was a rope put under a man- or hand-hole cover, an article known to me as a grummet.

The words arbor and mandrel have no definite meanings. A dictionary says an arbor is a shaft on which a cutting instrument, as a saw or milling cutter, is mounted; a mandrel is a shaft or similar arrangement on which the piece to be worked is mounted. A reader of the AMERICAN MACHINIST would never suspect the words of having the restricted meanings given above.

As a means of economizing time, in dating, the month is often represented by a number. This is all right when the order of writing is known. My earliest experience was with those who wrote the day first, but I soon encountered those who wrote the month first, and it looked as if the latter would control the situation, especially in the United States. A promi-

nent New York concern sent me a catalogue shortly after its publication, and its date was 30/11/'02. We can locate that date; but suppose it had read 3/11/'02.

In the use of arithmetic and algebraic signs some peculiar cases have come under my notice. Text-books are all agreed that — (minus) means that the quantity following it, that is to the right, is to be subtracted from the quantity before or to the left, but it is used very extensively on drawings as a sign of addition, being placed between the feet and inches. I do not recall a case of the kind in any printed matter, and have not been able to discover any sanction for it in any publication.

An amusing case of the uncertainty of English reached me a short time ago, in the shape of a clipping from a newspaper published in a city once my home. It was accompanied by the query, "Wouldn't that jar you?" The editor was extolling a former resident who had left to take charge of a concern built for the manufacture of heavy machinery. Among other things, he said: "Mr. Blank had several years' experience at *engineering* work in European countries, etc." This, while true, is misleading: as any one not acquainted would associate the hero's European life with offices and drawings. If we are to believe the hero's own tale, he was fourth engineer on a steamer engaged in coasting trade with countries on the Atlantic and Mediterranean.

Another expression, in common use, which does not convey a definite idea, is "executive ability." Advertisers call for it. Several years ago my attention was called to this uncertainty, and I have been observing those who were said to have it or were suspected. One peculiarity appeared in all I have seen, viz., carrying tales to the office. Possibly my cases have been exceptional.

These are enough to convey my idea. Can you not do something to establish uniformity in definitions of words and expressions in common use in the mechanical world? You have done well in standardizing catalogues, etc., also in cutting off useless letters from some words, even if you do write bushing, when bush, which means the same thing, would answer as well.

JAMES BELL.

The Division of Logarithms.

As a possible help to some who use logarithms I would like to suggest a way of preparing a logarithm for the extraction of roots when it has a negative characteristic. It may be old to some, but I have never seen it described.

Express the combined value of characteristic and mantissa as a single negative quantity by adding the mantissa to the characteristic. Then, after performing the necessary division, add + 1 to the mantissa obtained by division and —1 to the characteristic, making the mantissa positive again as required for computation.

For example let it be required to evaluate

$$\sqrt[3]{.3047}$$

$$\text{Log } .3047 = \bar{1}.48387$$

$$\frac{\bar{1} + 48387 = -.51613}{3} = -.17204$$

$$-.17204 + 1 - 1 = \bar{1}.82796 = \sqrt[3]{.3047}.$$

G. M. J.

A Wood Worker's View of Bronze Bearings.

Why do some makers of wood-working machinery persist in using brass or bronze bearings?

It is possible that a bronze bearing may wear a little, not much, longer than one of good babbitt; but, when it is once worn so that the shaft is out of proper alignment it is no small job to fix it, if as is usually the case in a wood-working shop, one is remote from a machine shop.

In order to get a good job one must send his shaft and have it turned—for it will have worn more in the middle of the bearings than at the ends—and have new boxes made; all of which involves expense and lost time, especially if one happens to be several days away from a machine shop (a benighted condition hard for a machinist to imagine, no doubt, but still common with wood workers), whereas, had the boxes been of babbitt, any good mechanic could have fixed them in half an hour and without any material dismemberment of the machine.

I have in mind the lathe on which I learned to turn. It was made in the highest style of the art, of those days, and had gun metal boxes, which were doubtless scraped to a fit when it was new; but, when a lathe head runs from 1,000 to 2,500 revolutions per minute, day in and day out, often with an unbalanced load, it's going to wear some, and that pretty soon, regardless of what the boxes are made of.

That bearing wore and I filed the brasses down; then the brass wore loose between the jaws of the frame and had to be wedged in; then it had to be wedged up from the bottom and filed some more. Finally, I chiselled out the whole inside of the thing, drilled a few shallow holes in it, and, blocking the shaft up where it should be, run a babbitt box. It really seemed to me that the babbitt wore better than the bronze; but, be that as it may, it took me only a few minutes, after it was chiselled out, to fix it *right;* and, had it needed another readjustment while I ran it (which it didn't), I could have run a new box in less time than it would take to file down the brasses.

And right here allow me to remark that one cannot, and never will, take the side shake out of a high-speed bearing by filing down the brasses. That method may be all right in cases where the wear is practically all in two directions, as in the piston rod and connecting rod bearings of an engine; but, in a wood-working or similar machine where the wear is all around, a brass box once worn loose can never be properly refitted. It's a case of a new box or a botch job.

Only a short time since I officiated at the installation of a gasoline engine, the main boxes of which were of brass, and so set that the whole thrust of the piston was directly against the joint between the halves. Now those boxes are going to wear—they may be filed down, but they will never fit properly again—and they will probably be turned around to bring the thick side against the thrust, and they will wear loose in the casting and have to be wedged tight again; and eventually the shaft will have to go to a machine shop to be fitted up with new boxes, while, I will venture to say, another engine, installed some years ago and doing twice the work, will be running right along, because the latter has boxes of babbitt so set that the thrust comes mainly against the bottom, and which can be renewed at any time in an hour or less.

No matter how much the shaft may be worn, provided it is round, the boxes may be made to fit without recourse to a machine shop. To a machinist, with a brass foundry next door, the making of a brass box is a small matter, but to a wood-worker it often means a delay of days, or even weeks, and a lot of expense which can as well be avoided by the use of babbitt.

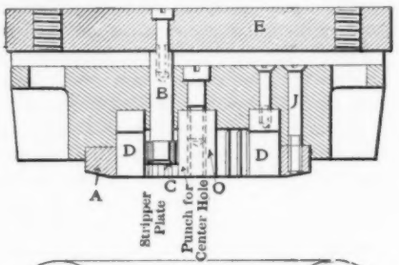
Speaking in the light (or the shadow) of twenty odd years of practical experience, I do not believe that, under average conditions, with a light shaft and high speed, a brass or bronze box will wear as well as moderately soft babbitt; but, admitting for the moment that it will, it is very seldom that conditions utterly prohibit a longer bearing; and if you increase the length of your bearing sufficiently to make its cost as much as that of the usual length of brass, it will certainly wear as well as that metal, and when it becomes necessary to renew, as it eventually must with either, the babbitt can be replaced at a tithe of the cost of the other.

I think that the common belief in the superior wearing qualities of the harder metals for boxes is based largely on imagination, and that, if the pounding and squeezing action of the shaft could be eliminated a box of lead would wear as long as any. Certain it is that hardness is not the only requisite of a good bearing; and that, under the conditions ordinarily existing in the case of wood-working machinery, a box which can be easily renewed, without recourse to a machine shop, is worth a dozen which cannot, even though it wear only half as long.

W. D. GRAVES.

Compound Armature Disk Die With Special Stripper.

Armature disks, as shown in Fig. 5, were produced complete in large quantities with the compound tool with special stripping arrangement attached, as shown in the sketch herewith. Work of this description is usually produced on presses having upper and lower die knock-out arrangements, thereby doing away with strippers in the dies; but the tool which is the subject of this article was made to be used on a press that had no knock-out attachment. Fig. 1 shows plan and section of the upper die; Fig. 2, plan and section of lower die; Fig. 3, end elevation of the complete tool; and Fig. 4, the special stripping arrangement. It was designed principally to overcome the difficulties usually associated with dies of this description; that is, to make them strip properly, which is rather difficult when the press is not fitted with knock-out, on account of the large amount of cutting edge which necessitates a considerable amount of power behind the strippers, and also because there is not room wherein to locate sufficient springs or rubber; that is, without making the tool very complicated.



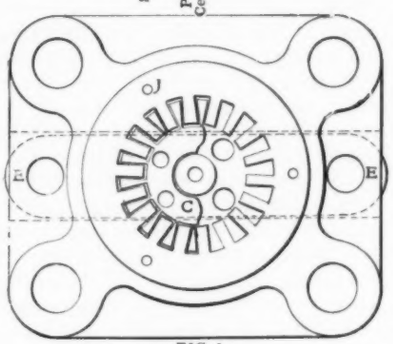
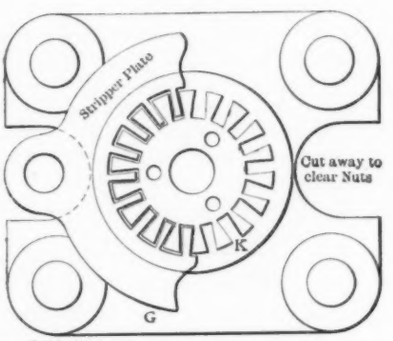


FIG. 1



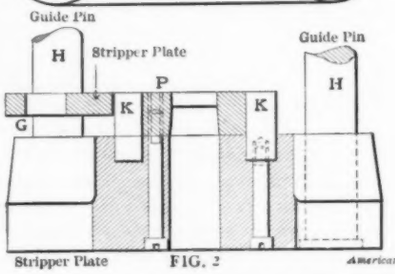


FIG. 2

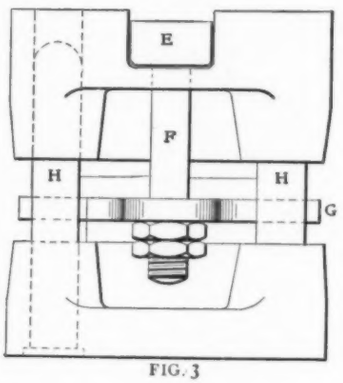


FIG. 3

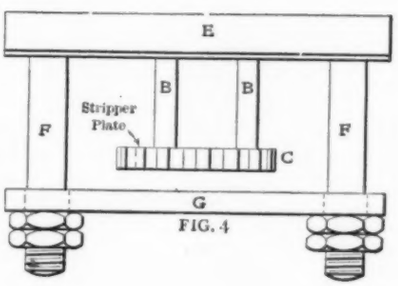


FIG. 4

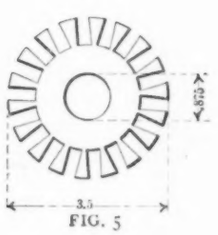


FIG. 5

COMPOUND ARMATURE DISK DIE WITH SPECIAL STRIPPER.

There is often a difference of opinion about the best way of stripping. Some will say a stationary stripper would be best for a particular job, when others prefer movable ones, and sometimes either would do equally well. Stationary strippers often distort the work, whereas movable ones straighten and hold down the stock before the tools come into operation; this is often of great importance when great accuracy is required. When springs or rubber, or perhaps both, are used, a considerable amount of power is often used up in compressing them before the actual work commences. This is a point that has to be considered, especially when the press is being taxed up to its limit of power.

As will be noticed, the body carrying the die for the central hole in the disk is at the bottom to allow of the scrap falling through the hole in the press body. The tool is sub-pressed by means of the four guide pins *H*, which are fixed in the lower die and are a good sliding fit in the upper die body. The blanking ring *A* for the outside diameter of the disk is located in a recess accurately turned in the body, and is held in position by the three screws *J*. The die for the slots is built up in segments *D*, so that if a part breaks it can be quickly replaced without destroping the entire ring. Each segment is held in position by a cheese-head screw from underneath. The punch *O* is for the central hole, and *P* is the die for the same; see Fig. 2. The hole is parallel for about ¼ inch to allow of grinding without altering the size. Below this it tapers off to allow the scrap to fall clear. The punch for the slots is built up in segments *K*, which are located and held in position in the same way as the die.

Now we come to the stripping arrangement, which is the principal feature of the tool. It is shown complete in Fig. 4. A bar *E* is located in a slot extending right across the back face of the top die. To this are attached two pins *F*, carrying the stripper *G* for the bottom die. This stripper is accurately worked out, so that it will slide nicely between the segments comprising the punch. It is is kept in position and adjusted by the lock nuts. *C* is the stripper for the top die. It also is attached to the bar *E* by means of four pins *B*. The projections are rather weak at the root, so to prevent their breaking off the stripper must be made thicker than would otherwise be necessary.

The action of the arrangement is as follows: On the downward stroke the strippers come down with the die till the stripper *C* rests on the stock. It then recedes into the upper die by an amount which is the difference between the thickness of the bar *E* and the depth of the slot in which it rests, its upward movement being limited by its coming in contact with the bolster. At this part of the stroke the bottom stripper is of course below the face of the punch, the bottom die body being cut away to clear the lock-nuts while in this position. On the upward stroke the bottom die stripper *G*, coming in contact with the scrap, strips it and at the same time, as the stroke is continued, brings down the bar *E*, carrying the top die stripper *C* to the bottom of the slot, thus ejecting the disk. The scrap and disk now lie loosely on the die, and so can be easily removed. It is not

necessary to describe the methods employed in making the various parts of the tool. The parts that need the greatest care in the making are the segments. All parts, with the exception of the bodies, screws and stripping arrangement, are hardened.

JOHN C. HAFNER and EMIL KLAPS.
Sheffield, England.

Right- and Left-Hand Engines.

In the shop where I am working, considerable discussion has arisen from time to time as to the proper way to determine the right and left hand of double engines.

A stationary engine, some claim, is determined by the position the man occupies who operates it. For instance, if he stands at the cylinder end facing the crankshaft, then the side at his right is right, and the side at his left is left; if he stands at the crank end, then it is just the reverse.

Others claims it is determined by whether the engine runs over or under. If, as before, the man stands at the cylinder end facing the crankshaft and the engine runs over, then the side to his right is right; but if the engine runs under the side to his right is left.

On an engine which propels itself, the usage in the shop where I am employed is to determine the right and left sides by the position of the operator, and the same rule applies to stationary engines also.

If this idea is correct, the placing of the throttle lever determines the right- and left-hand side of an engine. Believing the readers of the AMERICAN MACHINIST would be interested in this, I ask for information. What is the proper way to determine the right- and left-hand sides of double engines, whether they be stationary or portable; Also, how are we to distinguish between a right- and left-hand Corliss engine? ALPHEUS.

[We do not think there is any fixed usage in this matter, though the more usual method of deciding the question is, we think, to consider the operator to stand between the cylinders with his back toward the flywheel, the right and left cylinders being then on his right and left sides respectively. It has always seemed to us that this method is erroneous, and that the opposite nomenclature is correct. The usage seems to come from the location of the cylinders in a locomotive, which are thus correctly described, and while it may be defended for stationary engines on the score of uniformity, the same argument applied to boilers would lead to an absurd result. No one would think of calling the fire end of a stationary boiler the back end, and yet that must be done if we are to base the name on the position occupied in a locomotive, and we can see no more reason for taking the position occupied in the locomotive as a base of nomenclature in the case of cylinders than in that of boilers. It seems natural to us to call the flywheel end of a stationary engine the front end, the cylinder at the right of the operator when facing the flywheel being the right-hand cylinder, and *vice versa*. At the same time, as said above, the opposite nomenclature is, we think, the more common.—ED.]

Constructing the Isometric Circle

I herewith present three sketches showing three different constructions of approximate isometric circles in comparison with the true isometric circle. In all three illustrations, construction lines are drawn

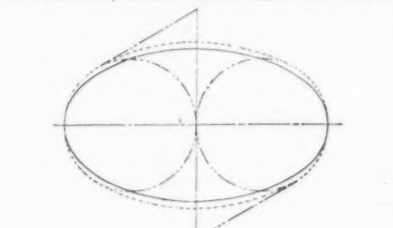


FIG. 1

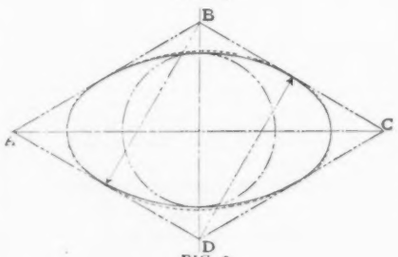


FIG. 2

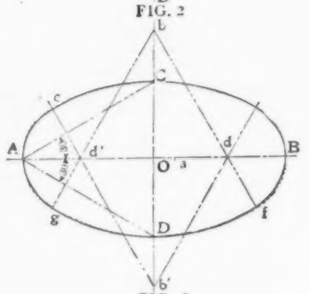


FIG. 3

American Machinist

CONSTRUCTING THE ISOMETRIC CIRCLE.

in as dash-and-dot lines. The approximate circle is shown dotted and the true circle by full lines.

Fig. 1 shows the construction given by A. Edward Rhodes, at page 31, and while, as Mr. Rhodes claims, it is very simple in construction, it is also the least accurate of the three constructions shown, whereas Fig. 3, which is the most complex in its construction, gives an ellipse which corresponds very closely to the true isometric circle.

Fig. 2 is constructed as follows: Draw the isometric square with sides to scale. With center at B, and radius of circle tangent to $A\,D$ at mid-length, as indicated by arrow heads, draw the long arc tangent to $A\,D$ and $C\,D$, and with the same radius and D as a center, draw the arc tangent to $A\,B$ and $B\,C$, thus fixing the length of the minor axis. Sweeping the radius of the axis so found across the major axis center line gives an approximate location of centers which will finish the ellipse. These centers are situated a trifle outside of the points, as shown, but are readily found by trial when the length of the major axis is known.

In any isometric circle, if the length of either axis is known, that of the other may be obtained by drawing 30 degree lines from the major axis center line to the minor axis center line, as $A\,C$ and $A\,D$ in Fig. 3. Construct Fig. 3 as follows: On the major axis $A\,B$ set off $Aa = C\,D$ = minor axis, and divide aB into three equal parts. With O as a center and a radius equal to the length of two of these parts describe arcs, cutting $A\,B$ in d' and d. With $d'\,d$ as a side, construct two equilateral triangles $d'\,b\,d$ and $d'\,b'\,d$. With b as a center and a radius equal to $b\,D$, describe $g\,D\,f$, intersecting $b\,d\,f$ and $b\,d'\,g$ in g and f. With the same radius and b' as a center, describe arc $c\,C\,e$, intersecting $b'\,d'\,c$ and $b\,d\,e$ in c and e. With A and B as centers and a radius equal to the hcord of arc $A\,c$, $A\,g$, $B\,e$ or $B\,f$, describe arcs, cutting $A\,B$ very near to d and d. From the points of intersection of these arcs, with $A\,B$ as centers and the same radius, describe arcs $c\,A\,g$ and $e\,B\,f$. This method may be used without drawing the isometric square and also gives a close approximation to any other true ellipse, the length of major and minor axes being given.

There is no claim of originality made for these methods of constructing the isometric circle, their claim to interest consisting rather in showing at a glance the comparative accuracy of the three methods as compared with the true isometric circle, and also their comparative simplicity of construction as compared with each other.

J. MELANCON.

Is This Success?

Several years ago, when I was an apprentice at a large steel works, the foreman always used to point out to me a young man named Tom as a sample of the ideal apprentice who is going to be successful in life. He would get quite enthusiastic and tell how Tom would be burning his midnight oil while we ordinary boys were in bed, and how he would get up early to finish his interrupted studies before coming to work, while we would be swimming or indulging in other time wasting useless sports.

I was duly impressed with all this, especially when the superintendent told his son practically the same thing the first day he started work, but somehow I could not bring myself to the point of working all the time, and less so after I considered Tom from the general standpoint. He was terribly thin and his complexion was a yellowish-white. In conversation he was dull and uninteresting; he was a poor mechanic, but he would turn out fairly accurate work by taking a lot of time and

working slowly. However, if you asked him the torsional strength of a shaft, the construction of a therotical indicator diagram, the formula for the flow of water through a vena contracta orifice, or any similar question he could generally give you the answer off hand. Still he did not seem to possess the faculty of applying his therotecial knowledge to practice. He indicated the No. 6 Corliss engine one day and after taking three or four cards off he found something wrong, and spent the rest of the afternoon trying to figure out what it was; by quitting time he was not finished, so he took the cards home and when I called to see him about 10.30 that evening he was still at it with the planimeter, a table of hyperbolic logarithms, a temperature entropy chart and a host of other things. I offered to help him, but he said he was afraid I could do nothing, for it was an extraordinary case of cylinder condensation and re-evaporation, together with the generation of much heat caused probably by excessive piston friction. I did not believe a complication like this possible, so picking up the wonderful card I had a look at it and it certainly was of extraordinary formation. It looked something like a double ended card, and a moment's consideration revealed the cause; he had left both valves open when indicating, and so got a cross between the crank end and the back end.

He was always doing things like this; he seemed to be exceptionally dull when it came to using common sense and very clever when he had straight problems to solve. However, he got along rapidly, first as draftsman, then designer, and two years after as chief draftsman, and so far he had justified the foreman's claims that he was a success in life, but before he was properly started on his $8,000 job his health broke down, his mind became deranged and then consumption attacked him; now he is in a sanitarium, and the doctors say he has very little chance to live through this year.

I don't think this man ever was on the road to success, I think he was misled by the many articles which have been written about success being directly proportional to the quantity of hard work done, and midnight oil burnt, by a man, Maybe I am wrong, but I believe in the need of looking to the physical as well as the mental development.

Perhaps some other readers will give their experiences in this line.

GEO. P. PEARCE.

Pausing uncertainly before a desk in the big insurance office, the Hiberian visitor said to the clerk,

"Oi want to tek out a pawlcy."

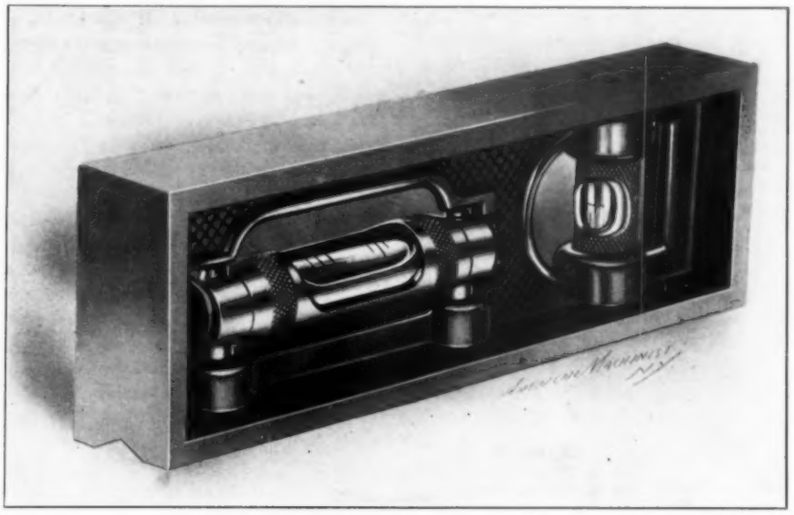
"Life, fire or marine," drawled the dapper clerk with infinite sarcasm.

"All three, Oi'm thinkin'," retorted the applicant. "Oi'm goin' fer a stoker in th' navy."

Machinists' Precision Levels.

At one time and another we have had a good deal to say about spirit levels and their use in machine shops. The ordinary spirit level is totally unfitted for such accurate work as the machinist is usually called upon to do, though it is used in many cases for work which its lack of accuracy and precision makes it utterly unadapted for. There can be no doubt, however, that a level made with care—so that it will indicate a level line with precision and then used intelligently might very much facilitate certain classes of work done in machine shops. Fine levels with glass bulbs which have been finished inside by grinding to the proper form do, in astronomical observatories and in instrument manufacturing establishments, the very finest of work, and we have described how E. P. Bullard, of Bridgeport, Conn., by the use of a fine precision level which he had made by a firm of instrument makers, succeeded in so leveling and adjusting his planers as to refine the planer work done in his establishment to such a degree that the amount of work required for scraping up the various sliding surfaces was very much reduced and superior work was produced. If, for instance, all parts of a planer table and its slides are tested with a fine sensitive level and it is known that the planer is precisely in line, and that the platen is level, if then, when setting work the work is tested by the same or a similar level, it is readily seen that the work may be placed parallel to the planer platen, and, of course, by the use of an accurate try-square work can be set vertical in the same way and levels can be made with such a degree of precision as to readily indicate an error much below what is usually allowed in such work in machine construction. We have long wondered why it was that no accurate and good level was offered for machinists' use, and we accordingly now take pleasure in introducing such a level by the Sawyer Tool Manufacturing Company, of Fitchburg, Mass., and shown by the accompanying illustration. This level has two steel tubes fixed in a frame made sufficiently heavy to avoid trouble from distortion by changes of temperature, and in these tubes, which are adjustable within the frames, are fixed glass tubes which have been accurately ground inside slightly larger in the middle and with a uniform curve in such a way that a given movement of the frame of the level produces a corresponding accurate movement of the level bubble, and the glass is graduated so that the position of the bubble can be noted precisely, and so that it can be brought back precisely.

Loose sleeves, placed outside the tubes and which can be rotated upon them, serve to cover and protect the glass when the level is not in use, and it is a refined instrument capable of doing work undreamed of by the average man who uses the average spirit level in machine-shop work. In the case of a 6-inch level, from which the engraving was made, and which we have had the privilege of examining and testing, it was found that pieces of paper 0.007 inch thick, placed under one end of the level, caused a uniform change of the position of the bubble within the glass of one graduation, and as these graduations are about ⅛ inch apart, it is readily seen that very small differences in level or inaccuracies are readily detected by the use of this instrument. In fact a piece of tissue paper 0.001 inch thick, placed under one end of the level referred to, caused a change of position of the bubble which was readily perceived.



A MACHINIST'S LEVEL.

There is a groove along one face of the level to be applied to shafts or other cylindrical objects, and the internal grinding of the level glasses avoids error which arises from inadverently tipping the level slightly sideways. These levels are made in 6, 9, 12, 18 and 24 inch lengths by the Sawyer Tool Manufacturing Company, Fitchburg, Mass.

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The Peace Conference and After.

The momentous peace conference which as we write is going on at Portsmouth is a subject which may engage the attention of even a technical journal, and we feel sure that all our readers will join us in the hope that the conference will result in ending the wholesale killing of men, called war.

The terms of peace fixed upon by Japan are reported to be moderate and to be designed to "save the face" of Russia, though it is quite certain that had Russia been victorious no terms designed to spare the feelings of Japan would have been offered. The terms, which in that case would have been prescribed by the grand ducal war party would almost certainly have been designed to humilate and crush Japan to the uttermost.

For the position in which Japan finds herself to-day she may give thanks to the modern spirit of organization and thorough systematization, together with the fact that her leading men in civil, official and military circles have so fully recognized the importance of systematic procedure based upon previously thought-out plans and carried on by men trained to a high sense of honor and the sacredness of public responsibilities. It has almost seemed that Japan's military operations have been carried on after the plan of our most successful manufacturing establishments. Every man has seemed to be in the right place at the right time and to stay there until the task assigned him had been completed, or death relieved him of responsibility.

At the close of the war, which now seems not far off in any event, Japan will be, in a sense, a new nation. She can never be the same as before. Her people have found out, not only that there are many things to be done which they have not been accustomed to doing, but that they can do them as well as anybody. They will do these things and probably will do them well. The industrial development of Japan will probably be very rapid—even more rapid than that of Germany following the close of the Franco-Prussian war. Japan is fairly well supplied with iron and coal deposits, and her commercial relations with China are apt to be such that whatever she lacks in these minerals will readily be obtainable from her neighbor. Her people have shown their capacity for and their readiness to take up with the ideas and practices of the most advanced peoples of other lands, and altogether Japan will be a nation whom it will be well worth while to be upon good terms with. As matters now stand, England and ourselves seem to be upon the most favorable footing—at least so far as such footing is affected by considerations of friendship and mutual good understanding; but it is to be remembered that the radical differences in the fiscal policies of the two nations are almost sure to have an important effect upon the future development of trade with Japan. It is a truism that international trade is, in the long run, international exchange of goods. Except for the goods sent abroad to pay dividends, rents and interest, goods are exchanged for goods, and, right or wrong, there can be no reasonable doubt that England's policy thus favors the exportation of goods, while ours has the opposite tendency.

It is to be hoped, at any rate, that if there should be such a thing as preferential rates upon machinery imported into Japan our American machinery builders will not be practically the only builders who will fail to be in a position to take advantage of it, as is the case in our machinery trade with most of the nations of Europe that have preferential rates.

And while Japan has profited by the influx of new ideas Russia seems to have encountered increased difficulties as an indirect result of the same ideas. For those most familiar with Russia are generally agreed that the introduction of American and other machinery and the gathering together of workmen from all parts of the country in workshops where they met and conversed about matters of mutual concern, and where the process of education always resulting from such intercourse has gone on, has been the most fruitful secondary cause of Russia's internal difficulties; these difficulties in turn being one of the chief, if, indeed, not the chief, cause of her practical inability to continue the war. The locomotive works at Sormovo, for instance, in which so many Americans were eight years ago directly or indirectly interested, is said to have become one of the centers of light and leading, or of sedition and rebellion, according to one's point of view. True there was a large works there before and they had built railway cars and steamboats, but the locomotive works brought a number of new men there who, though probably for the most part without the least intention of doing so, yet did give to many Russians with whom they came into contact new ideas of what manhood consists of and of what are the elemental human rights of which no man has a right to allow himself to be deprived. Thus the introduction of improved machinery and of modern factory organization has seemed to have proven entirely incompatible with many features of Russian social organization, and instead of strengthening, as has been the effect in Japan, they have proven a source of weakness. On this we see one more proof of what has long been perceived by the more discernable, *i. e.*, that machinery and modern industrial methods may have widely varying effects depending upon circumstances. We hope and believe that their ultimate effect will always be on the right side.

It is reported that a conference has been held between our ambassador at St. Petersburg and the Russian "Ministers of Finance and Foreign Affairs" (supposed experts chosen by the Tsar and in whose hands the question of imports is placed), which may result in some improvement of the status of affairs in respect to the importation of American machinery into Russia. Certainly, there is vast room for improvement along that line, and the treatment American machinery builders have received, really at the behest of the supar trust, has been most outrageous—many a machinery builder having been less well supplied with orders on account of this interference with his Russian business, while at the same time he and his men have been compelled to pay the price for their sugar which the provokative action against Russia was intended to enable the sugar trust to maintain.

"Every rope used in the British naval service, from heaving line to hawser, wherever used on board ship, or in dockyard," said the head of a large rope manufactory recently, "has woven into one of its strands, for purposes of identification, a colored thread. A different color is used according to the port of manufacture. red, blue, green and yellow being adopted for different ports. The presumption is that any rope with the colored thread found outside of such uses is in improper hands. This custom has prevailed in the British navy since long before the days of Nelson, as far as I am aware. A similar method of identification is employed to some extent commercially. Some railways mark their rope in this way, and it is also sometimes employed for identifying ropes which, used for the transmission of power in operating machinery and in lighters, would be liable to be stolen."—*Engineer & Iron Trades Advertiser.*

Rear-Admiral Charles Edgar Clark, a member of the general board of the navy, reached the age of sixty-two, August 10, and was placed on the retired list. As captain of the *Oregon*, he became famous in 1898, having brought his vessel from San Francisco around Cape Horn to Key West, a distance of 14,000 miles, arriving with everything in first-class order, so that the *Oregon* was able to take a prominent part in the work of annihilating Cervera's fleet at Santiago. Admiral Clark was born in Vermont, fought in the civil war and was at Mobile Bay with Farragut.

In a recent test of a Kruppized armor plate at Sandy Hook proving grounds, an Isham shell (illustrated at page 49, Vol. 26), which contained 177 pounds of dynamite, was fired from a 12-inch gun at a distance of 500 feet from the target. The latter was driven backward a few inches by the shock, but was uninjured, aside from a 12-inch dent in the face.

New Tools and Machine Shop Appliances.

THE "AUTOMATIC" CLUTCH.

Fig. 1 shows this clutch mounted on a gear shaft; Figs. 2 and 3 show the mechanism. In the sectional view, Fig. 2, it is represented in the disengaged or "off" position. *A* is the operating sleeve which carries the pins *B* and *C*, shown in section, which fit between the faces of the

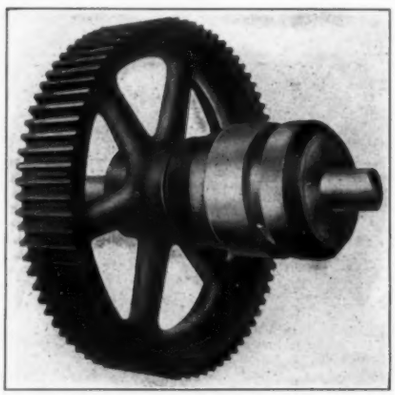


FIG. 1. THE "AUTOMATIC" CLUTCH.

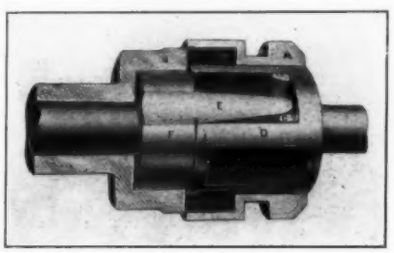


FIG. 2. SECTIONAL VIEW OF CLUTCH.

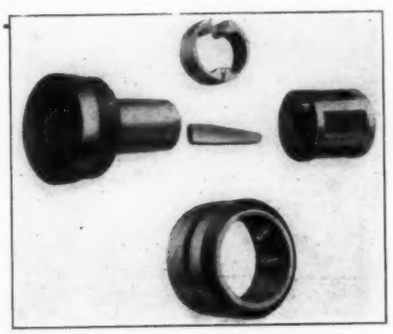
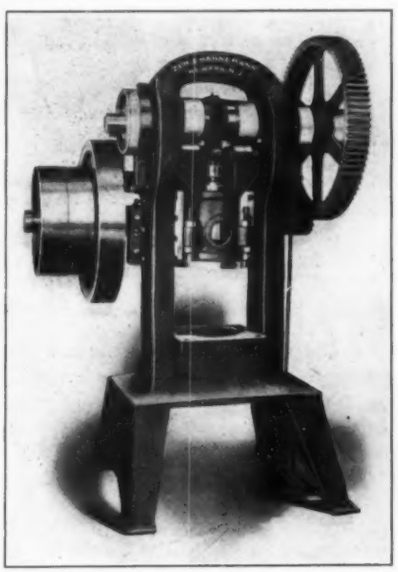


FIG. 3. CLUTCH PARTS.

cavity in the keyed member *D*. Loosely placed between the pins *B* and *C* is a lever *E*, which extends between the ends of the expansion ring *F*, which is surrounded by the cup or loose member *G*. Now if the keyed member *D* be rotating in the direction indicated by the arrow, the ring is freely revolved by the lever *E*, which is driven at point *x*, as pin *C* is free of the lever; and pin *B* operates on the lever only when the member *D* is revolving in the opposite direction. When the clutch is engaged by means of a shifter the sleeve *A* is moved to the left, and the pin *C* gradually relieves the bearing point *x* on the lever, and the member *D* drives the ring by the lever through the pin *C*. This causes the lever *E* to expand the ring *F* within the cup *G*, with such pressure that the friction created exceeds the force on the lever, therefore the greater the load the tighter the grip. The Automatic Clutch Company, Akron, Ohio, is the maker.

DRAWING PRESS.

This press is of the well-known arch or straight-side type, and the blank-holder is operated by cams. The main advantage claimed for the press lies in the arrangement of anti-friction rollers. These are placed in oil pockets made with the outer slide, and are not to be adjusted every time a new die is inserted; thus an even



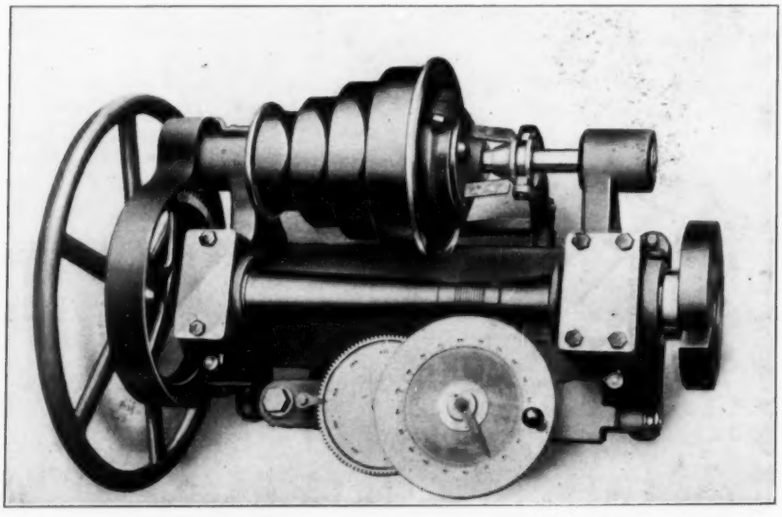
DRAWING PRESS.

contact of both rolls against the cams is insured. The adjustment for various heights of dies is accomplished by an independent sleeve in the other slide. The cams and rolls are wide, to reduce the wear, and are hardened and ground. The shaft is heavy, especially in the wrist, and its bearings, as well as the slide guides, are carefully scraped. A countercam raises the outer slide positively. The press is geared 1 to 6, and has a distance between upright of 17 inches. The plunger has a 6-inch stroke, the blank-holder a 3-inch. The total weight of the press is 5,500 pounds. The makers are Zeh & Hahnemann, Newark, N. J.

20-INCH GEARED MAGNET AND FIELD COIL WINDING HEAD.

This machine is especially designed to wind magnet and field coils with the proper number of turns of wire for the required resistance of the dynamo, motor or other kindred apparatus. To accom-

plish this, the compound registering mechanism has been made an important feature, and by means of this any number of revolutions between 0 and 1,000 made by the spindle can be ascertained at a glance. This mechanism consists of a worm cut in the spindle and meshing with a worm-wheel, which in turn drives the proper spur gears. The gears are mounted on an arm, which is supported by brackets cast solid with the headstock. On one end this arm is hinged, while the other end is held in place by means of a pull-pin. When desiring to bring the register back to zero, it is only necessary to release the pull-pin from its socket by means of the knob shown, and draw the arm a sufficient distance away from the headstock to disengage the worm and worm-wheel from one another, and then, with the aid of the handle on the worm-wheel, revolve the latter sufficiently to bring the mechanism to the desired mark. The pull-pin is then replaced in its socket, and the machine is ready for the next piece of work. The headstock is well ribbed and proportioned to withstand any strains that it may be subjected to. The spindle is solid, with a front bearing 3 3-16 inches diameter by 5¾ inches long and a back bearing 2 11-16 inches diameter by 4¾ inches long. At the back end of the spindle a large hand-wheel has been placed for the purpose of obtaining the exact number of turns by hand, which the momentum of the revolving parts, when driven by a belt, would not permit. The spindle is driven from the cone shaft by means of spur gears, as shown. The cone pulley, having four steps, 11¾, 10, 8¼ and 6½ inches diameter for a 2½-inch belt, rotates freely on the cone shaft, but may be attached to or released from the shaft at the will of the operator by means of a friction clutch operated by a connecting rod and counterbalanced treadle. The friction clutch is of an improved design, and has ample provision for taking up wear. The countershaft cone pulley has steps of the same diameter and width of face as the cone pulley on the head. The builders are Greaves, Klusman & Co., Cincinnati, O.



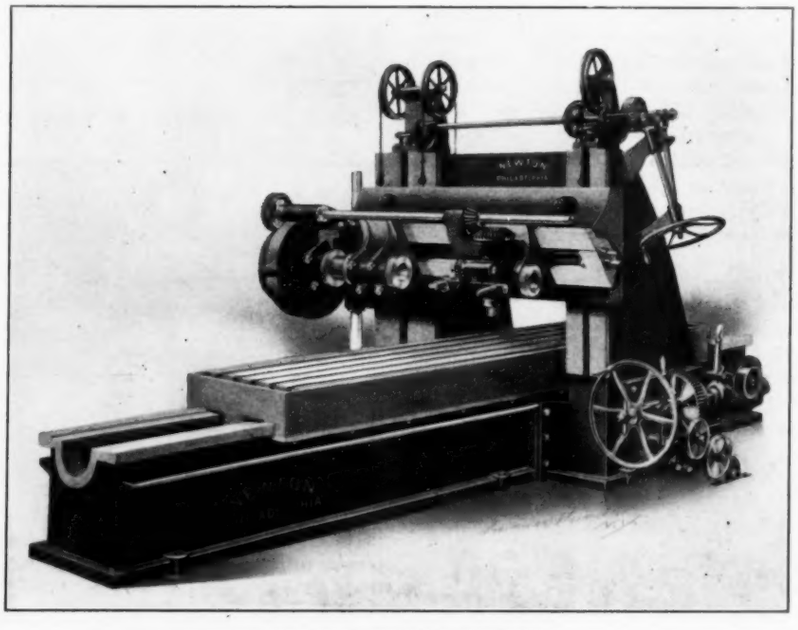
20-INCH GEARED MAGNET AND FIELD COIL-WINDING HEAD.

A NEW SLAB MILLING MACHINE.

The accompanying illustration shows a new heavy slab milling machine, which is a recent product of the Newton Machine Tool Works, of Philadelphia. The capacity of the machine is 36 inches by 20 feet, the extreme distance between the center of the main spindle and the table being 32 inches.

A new feature will be seen in the addition of an auxiliary vertical spindle, which is mounted in the outboard bearing of the main spindle. This spindle is 3 inches in diameter, and has a vertical independent micrometer adjustment of 2 inches. It is also adjustable across the full width of the table, and, if desired, may have an automatic cross feed.

The main spindle is 6 inches in diameter and will swing cutters up to 12 inches diameter. It has an adjustment of 6 inches on the cross-rail, for convenience in setting the cutters. The table is operated by a spiral pinion and rack, and has a variable feed through friction discs. It has also quick power traverse in both directions.



A NEW SLAB MILLING MACHINE.

The Japanese Tariff.

BY A. F. TENNILLE.

The Japanese tariff of the present year provides that the dutiable value of imported articles shall be the actual cost of the articles at the place of purchase, production or fabrication, with the addition of packing charges, cost of transportation, insurance and all other charges incurred up to the arrival of the articles at the port of importation. In the event that an article is dutiable under more than one rate of duty, it is to be assessed according to the highest of such rates. Special war duties are imposed in certain instances, and these became operative on July 1 of the present year, and are to remain in force until one year after the close of the war. Japan also levies varying rates of duty, having a general and conventional duty, consumption and special consumption taxes, and now the additional war tax. The United States is classified with those having the "most-favored nation" treaty, thus entitling her goods to entry at the conventional or lower rate of duty. It is also arranged that the war tax is not to be levied upon goods imported from those countries sharing the privilege of the most-favored

nation clause, *provided* they are accompanied with an authorized certificate of origin.

The following are the rates of duty of interest to the trade:

Arms and ammunition, such as cannons, muskets, pistols, side-arms, projectiles, cartridges, etc., 25 per cent. *ad valorem;* war tax, 5 per cent.

Balances, measuring scales, etc., 10 per cent.; war tax, 10 per cent.

Electric light apparatus or instruments and parts thereof, 10 per cent.; war tax, 5 per cent.

Fire engines and parts thereof, 10 per cent.; war tax, 5 per cent.

Implements and tools of farmers and mechanics and parts thereof, 5 per cent.; war tax, 5 per cent.

Surveying instruments, 10 per cent.; war tax, 5 per cent.

Locomotive engines and parts thereof, 10 per cent.; war tax, 5 per cent.

Machinery or machines, engines of all kinds and parts thereof, not otherwise provided for, 10 per cent.

Printing machines, 5 per cent.

Pumps and parts thereof, 10 per cent.

Sewing machines and parts thereof, 10 per cent.

Sporting guns and accessories, 25 per cent.; war tax, 10 per cent.

Lead shot, $1.089 per 100 kins, equal to about 133 pounds.

Steam engines, boilers and parts thereof, 10 per cent.

Anchors, 10 per cent.

Belting for machinery, of leather, rubber or canvas, 10 per cent. *ad valorem* and 5 per cent. war tax.

Brass pipes and tubes, duty, $2.45; war tax, $1.04 per 100 kins.

Brass screws, duty, 10 per cent.; war tax, 5 per cent.

Cable, submarine, duty, 10 per cent.; war tax, 5 per cent.

Cars or carriages, railway, passenger, duty, 10 per cent.; war tax, 5 per cent.

Cars or carriages, tramway, duty, 10 per cent.

Cars and wagons, freight, duty, 10 per cent.

Chain cables, 10 per cent.

Copper pipes and tubes, duty, $2.96; war tax, $1.24 per kins.

Copper wire, $3.14 per 100 kins; war tax, 5 per cent. *ad valorem.*

Detonators, duty, 15 per cent; war tax, 10 per cent.

Vessels, steam and sailing, duty, 5 per cent.; war tax, 5 per cent.

L. T. Bassett, of 28 Fournier st., Worcester, Mass., is introducing a method of cementing leather belts,, by which a very short lap only is required, and in which it is guaranteed that the strength of the joint will be equal to that of the belt.

A "stone" of live meat equals 14 pounds. A "stone" of dead meat equals 8 pounds. A "stone" of cheese equals 16 pounds.

An Improvised Air Compressor.

BY JOHN J. SMITH.

It might be said that one would never know how high he could jump until he knew how deep a hole he would get in. An illustration of this fact is found in the following experience, which may perhaps be of use to others.

When a blast-furnace gets into a certain condition, which I will not attempt to describe, it is necessary to make holes through the walls to draw off the contents of the furnace at places where no provision was originally made, or where the holes originally provided have become stopped with an infusible mass of iron and cinder. After drilling into one of these masses, or into the wall of the furnace itself, with an ordinary churn drill for a certain distance, the material encountered becomes sufficiently hot to be slightly pasty and to stick the drill, simultaneously drawing its temper. At the same time this pasty material is very much too hard to drive a bar through, and is absolutely infusible under any but the most intense heat. One of the favorite methods for making a hole into such a mass, where the electric arc is not at hand, is by means of an oil blow-pipe, which works on the same principle as the ordinary plumbers' lamp, increased in size about one hundred-fold, the interior pipe for carrying the kerosene being ¼-inch gas pipe, and the exterior one carrying the blast of air being ¾-inch gas pipe. Having a furnace in the lamentable condition mentioned above, a blow-pipe of this description was urgently needed, but no source of compressed air

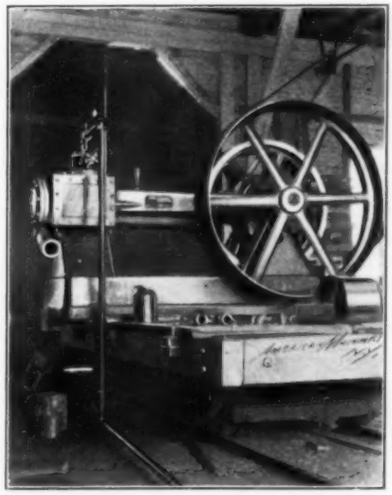


FIG. 1. AN IMPROVED AIR COMPRESSOR.

factory results, but as a result of the oper- to supply the blast was at hand. The pressure of blast on the furnace was about 10 pounds, and this in desperation was tried for the blow-pipe, with fairly satisation of the blow-pipe, the cinder "notch" was burned open and also an additional tuyere, the furnace loosened up and the blast pressure fell to about 5 pounds, so that it was no longer sufficient to operate the blow-pipes, though they were still urgently needed for further servce. After much casting about for a possible source of compressed air, I remembered that we had on hand a 6½x10-inch single-valve Buckeye engine, and I said to the master

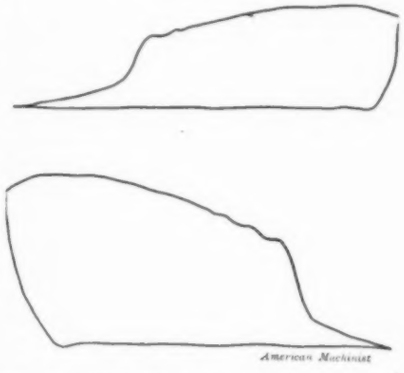


FIG. 2. INDICATOR CARDS FROM IMPROVISED AIR COMPRESSOR.

mechanic that we would belt this up to the line-shaft in the carpenter shop (which happened to be the nearest), drive it backward with the shop engine and take compressed air from the steam or inlet side of the cylinder. He was skeptical of the proposition at first, but I reminded him that a steam card and air card were simply opposites of one another, and that the valve-gear diagram for an air compressor with positively-moved valves was simply that of a steam cylinder running in the opposite direction; and cited the familiar fact that a locomotive reversed when running down hill will pump air at a lively rate.

The practicability of the scheme being more or less settled from this point of view, I was lamenting that no larger engine was at hand, so that a greater volume of air could be obtained, when the master mechanic called my attention to the fact that we had just received a 10x12 inch Straight-line, for an electric light plant then under way, which was still standing on the flat car on which it had been brought to the works. I had completely forgotten this as an available air compressor, but immediately had it sent for and placed in the carpenter shop on the track which ran parallel to the line shaft. The engine was then turned crosswise on the car, the belt from one of the wood-working machines run to it, the engine slewed back and forth until the pulleys were in line, as shown in Fig. 1, and the shop engine started. In the meantime a line of 1½-inch pipe had been run to the furnace, some 250 feet away, and in a very short space of time we had 12 to 15 pounds pressure on the discharge pipe, which, of course, came from the throttle, and were operating our blow-pipe with great satisfaction. We subsequently made another blow-pipe and put it to work, doubling

the speed of the engine at the same time. The pressure then went to 25 or 30 pounds, but the effect on the blow-pipes was very beneficial, and we continued to operate them, with the utmost satisfaction, whenever and wherever we desired until the trouble was over. When this happy time arrived, as a matter of interest I put indicators on the engine while still in the original position, and obtained indicator cards from it. Not having two springs of the same strength, I used a 20-pound spring on one indicator, and a 30-pound spring on the other, which accounts for the difference in the height of the cards shown herewith in Fig. 2. I also got a photograph of the entire layout in all its crudity, which is reproduced herewith. I supposed at the time that a better air card could be made by blocking the governor up, so as to give an earlier cut-off, but it was not the time to consider refinements of that character, and nothing of the kind was done.

Later on we were in sore straits for an air compressor to drive a rock drill at a small outlying mine where we had steam power but no compressed air, and where the need for the latter was known to be temporary. Encouraged by the previous experiences, the 6½x10 inch Buckeye previously mentioned was tested with the idea of using it for the purpose, the rock drill being a very small one, and the quantity of air required only about 80 cubic feet per minute. It was at first impossible to maintain a pressure on the receiver of over 35 or 40 pounds, but a little investigation proved that the engine, which had done ten years of good service before being put aside for reasons not connected with its ability to do its work, had completely worn out its piston rings, and had also worn them very loose in the grooves. The grooves were trued up and new rings fitted, after which it was possible to produce a pressure of 75 or 80 pounds on the receiver.

The objection to an arrangement of this sort is that the clearance space is very great, and the re-expansion from it reduces the air introduced on the suction stroke, and the higher the pressure the worse this action; so much so that a very decided "puff" or back-kick from the suction can be felt at each stroke, when running against these high pressures.

When this engine was first sent to the outlying mine where it was to do duty as a compressor, it would not keep up the pressure, but the machinist sent to erect it observed this series of back-kicks and put a check valve on the in-take, which so far bettered matters that although there was only one check valve for both ends of the cylinder, the loss of air was so cut down that the compressor was able to maintain the pressure, and did so for a number of weeks, until the temporary task for which it was sent was accomplished.

The indicator cards from an engine run under such conditions are by no means ideal compressor cards, and the lack of economy is something calculated to horrify a college professor, but for a temporary expedient when a proper compressor is not to be had, an engine run backward with a plain slide valve set to "cut-off" about half-stroke will do fair duty, and will produce the desired result. It is not under any circumstances to be recommended as a compressor for permanent service, but may help someone out of sore trouble, as it did us in the cases described.

We have received from Charles A. Francis, a copy of the Journal of the Society of Mechanical Engineers, of Tokyo, Japan, which is a very creditable publication, the number before us containing, "Notes on Electric Power Plant," by Y. Nogami, M. E.; "On Locomotives," by G. Shiba, M. E., and among other things specification of a 14-inch engine lathe for the Higher Technological School of Tokyo. These specifications being based upon the Bradford Machine Tool Company's standard engine lathe.

New Publications.

"Marine Engines and Boilers." By Dr. G. Bauer. Translated from the German by E. M. Donkin and S. Bryan Donkin. Edited by Leslie S. Robertson. 744 6x9-inch pages with 535 illustrations. Crosby, Lockwood & Son, London; the Norman W. Henley Publishing Company, New York. Price, $9.

This is a superb piece of German thoroughness in technical book-writing, and English-speaking engineers are under large obligations to the translators for their painstaking translation—a translation that has involved an enormous amount of work in converting the numerous formulas and tables from metric to English units of measurement. Every phase of marine engine and boiler design, as well as of the larger problem of engining a ship, is discussed in a manner which is a model of such work. The illustrations are numerous and excellent, while the tables supply a large number of data not elsewhere readily accessible. While devoted strictly to the marine engine, large sections of the book are equally adapted to the use of the stationary engine designer.

"Mechanical Drawing." By C. L. Adams. Boston, Geo. H. Ellis Co. 204 8½x11-inch pages, with 23 full-page plates and 159 test cuts. Price, $3.

We must express our conviction that mechanical drawing as a subject for book writing is more than exhausted. Every teacher of the subject seems to think that he must have a book of his own writing, and the result is a flood of such books for which there is no legitimate call. The worst of it is that most of these books give obvious evidence that their authors have had no experience in the drawing office, their acquaintance with the subject being purely academic. Most of these authors could, in fact, learn more of what a student of drawing needs to be taught from Mr. Griffin's little pamphlet than from any dozen of their contemporaries' more pretentious publications. The spirit of all of them is entirely foreign to the drawing office. They extoll mere manual execution above everything else and cultivate mere fussiness, the result being that the students trained in such methods are about as helpless before the real work of the drawing office as a landsman at sea.

The present book is no exception to the rule. It gives the most minute instruction in matters that are of no possible importance, and gives the student a fatally wrong impression of the whole work of a drawing office. As examples we may cite the drawing of handles of common carpenter's saws; the drawing of a simple three-pronged wardrobe hook and of another thing which we take to be a cam, which are fairly comical and such as no one ever saw in a factory where such things are made.

"Procédés Métallurgiques et Etude des Métaux." By M. U. Le Verrier, Engineer in Chief of Mines; Professor at the Conservatory of Arts and Trades. 403 8½x10-inch pages. 194 figs. Gauthier-Villars, Paris. Price, 12 francs.

This treatise on "Metallurgical Processes and Study of Metals" is one of a series by the author of "General Metallurgy," which, in turn, forms part of an industrial encyclopedia founded by M. C. Lechalas, inspector-general of bridges and roads, retired, with whose autograph each copy of this volume is inscribed. In the book before us the author has made it his aim, while giving the principles of metallurgy, to present especially the more recent progress therein and to treat the subject in its general features, the metallurgy of iron having been handled in another volume. The topic considered may briefly be outlined as follows: Ores, drying, calcination, roasting, extractive operations, fusion and refining, thermochemistry, accessory installations, mechanical tests, action of heat, metallography, alloys, etc.

"Hydraulic Power Engineering." By G. C. Marks. Second edition, 588 5½x8-inch pages, with 236 illustrations. Crosby Lockwood & Son, London; D. Van Nostrand Company, New York. Price, $3.50.

This book treats of both hydraulic motors or water-wheels and hydraulic machinery. The former division is the subject of many treatises, but the opposite is true of the latter. The discussion of this class of machinery is quite detailed and is full of importance. Thus we find chapters on packings, pipe joints, valves, accumulators, presses, sheet metal working and forging machinery, riveters and

pumps. The division of hydraulic motors includes a chapter on hydraulic engines. The concluding chapter is on recent achievements and includes several striking modern pieces of hydraulic work.

Business Items.

On September 1 G. Edward Smith and William Robinson will enter into a partnership as engineers under the firm name of Smith & Robinson, and will be located in room 605, Provident Building, Philadelphia.

The American Drop Forging & Tool Company, Wayland, N. Y., has recently voted to increase its capital stock, and added a lot of new and improved machinery in order to handle its rapidly increasing business.

The Pratt & Whitney Company, of Hartford, Conn., has made arrangements with the C. T. Patterson Company, Ltd., of New Orleans, La., to represent its small-tool department in the Southwest territory. The Patterson Company has a very complete line of the small-tool product, and is in position to fill orders from its New Orleans establishment.

The Hamden Manufacturing Company, Hamden, Conn., has just started in on its seventieth year. The business of this old firm has increased to such an extent that it finds its present quarters inadequate and is having plans drawn for a new factory. About one-half of the business of this firm is export, and it has recently opened a branch office in Havana, and proposes to open offices in South Africa and Australia.

Manufacturers.

The Gould Manufacturing Company will enlarge its plant at Seneca Falls, N. Y.

Capitalists are projecting the erection of a large tinware factory in Clarksburg, W. Va.

The City Manufacturing Company, New Bedford, Mass., will erect a large warehouse.

The Moline Plow Company is making plans for the erection of a factory in Rock Island, Ill.

The Singer Manufacturing Company, Elizabeth, N. J., will build large additions to its plant.

It is reported that the Beaumont (Tex.) Iron Works will enlarge its plant in the near future.

The American Car & Foundry Company will largely increase its plant at Jeffersonville, Ind.

Work is rapidly progressing on the new shop of the Allis-Chalmers Company, at Milwaukee, Wis.

The Continental Steel & Iron Company, of Cincinnati, Ohio, is to erect a large plant at Rahway, N. J.

The plant of the New Orleans Acid Fertilizer Company, Gretna, La., was destroyed by fire; loss $20,000.

The Eagle Lock Company, Terryville, Conn., is building a 200x40-foot extension to its present building.

Heavy floods caused many of the largest industries in Bridgeport, Conn., to shut down for several days recently.

The Oster Manufacturing Company, Cleveland, Ohio, will enlarge its plant by the erection of a $45,000 building.

Joseph Honhurst will build a sheet metal manufacturing factory at 1016-1018 West Sixth street, Cincinnati, O.

The Lorain Shovel & Stamping Company, Lorain, Ohio, is contemplating the erection of a plant at Findlay, Ohio.

The Rushmore Dynamo Works, Plainfield, N J., will largely increase their capacity by the erection of new buildings.

The E. W. Hulse Company, Columbus, O., will enlarge its factory by the addition of a 30x100-foot, two-story extension.

The Buffalo (N. Y.) Specialty Manufacturing Company has purchased property on Ellicott street and will enlarge its plant.

The Elwood Lawn Mower Factory, Elwood, Ind., is to double its capacity by the erection of a large addition to its present plant.

Contractor H. L. Morehouse is to erect two factory additions at the plant of the Peck, Stow & Wilcox Company, at East Berlin, Conn.

The Portland (Ore.) General Electric Company is arranging to construct a 40 horsepower plant on the east side of the Willamette River.

The Continental Motor Company, of Chicago, will remove its plant, which gives employment to about 175 employees, to Muskegon, Mich.

The Buffalo (N. Y.) National Corundum Wheel Company will build a one-story brick factory at Main street and Erie crossing, at a cost of $9,000.

Articles of incorporation have been filed by the Mayo Radiator Company, of New Haven, Conn. The new concern will give employment to 100 hands.

Fire in the establishment of the American Industrial Company, 63-65 Canal street, Chicago, Ill., caused a loss of $25,000; losses covered by insurance.

The Van Dorn Iron Works Company, East Madison avenue and Nickel Plate Railroad, Cleveland, O., will erect a large brick and steel factory building.

Milliken Brothers, New York, will erect a large rolling mill plant at Staten Island, N. Y. This firm has recently increased its capital to $5,000,000.

The Kirkendall Shoe Manufacturing Company, Omaha, Neb., will erect a $25,000 addition to its present factory. Alfred Millard has the matter in charge.

The Meyer Machine Company, Petersburg, Ind., has purchased the implement business of Paterson & Miley, and is making preparations to increase its plant.

The Shaw Machine Company, Lowell, Mass., has begun work on its new factories. Only high-speed tools of modern make will be employed in the new factory.

The Diamond Match Company, Menominee, Mich., will erect a new factory building at Cloquet, Minn. E. J. Ellenwood, Menominee, Mich., is making arrangements.

William Steele & Sons are estimating on a two-story addition, 50x47 feet, to the factory of the Miller Lock Company, at Duncan and Melrose streets, Frankford, Pa.

The plant of the Pittsburg Pulley Company, Crafton, Pa., has been destroyed by fire at a loss of $85,000, which is covered by insurance. The plant will be rebuilt.

Plans have been filed by the Cling Surface Company, Buffalo, N. Y., for a one-story factory building at Nos. 1040-1048 Niagara street. The cost will be $12,000.

Niagara Falls is to have another important industry in the establishment of a plant to utilize the discovery of Z. G. Sholes, of a cheap method of refining iron-ore.

William Steele & Sons are estimating on a two-story foundry, 45x152 feet, and a one-story foundry, 44x152 feet, at Second street and Glenwood avenue, Philadelphia, Pa.

It is proposed by the Vance Cotton Mill Company, Chattanooga, Tenn., to enlarge the mill and install additional machinery. J. C. Vance, of Urbana, O., should be addressed.

The recently organized United Drop Forging Company will locate in Merrick, Mass. The plans call for a main building, 90x60 feet, and for a number of smaller buildings.

Work will be commenced in the fall on the construction of a new factory, 60x150, for the Jensen Manufacturing Company, 523 Jackson street, Topeka, Kan. W. J. Dickie, president.

As soon as a suitable site can be secured, the American Car & Foundry Company, of St. Louis, Mo., will erect a $1,000,000 plant in Birmingham, Ala. M. E. Duncan can give information.

A project is on foot to erect a $150,000 steel-casting and machine shop in Alliance, Ohio. W. F. Watson, formerly connected with the American Steel Foundries Company, is interested.

The increasing business of the Lebanon Chain Works, Lebanon, Pa., has necessitated its enlargement to increase its facilities. A new addition, 120x200 feet, is to be built, at a cost of $25,000.

Wanner & Stinson, Philadelphia, Pa., have posted plans and invited bids for the three-story factory, 60x110 feet, at 537 to 541 North Third street, for the United States Paper Box Company.

W. A. Chapman & Co., of Providence, R. I., have been awarded the contracts to build the four-story factory building for the Sherman Elevator Company at the corner of Prescott and Otis street, Worcester, Mass.

Dodd & Struthers, Des Moines, Iowa, manufacturers of copper cable lightning rods and didactic electrical machinery and appliances, will incorporate with a capital stock of $750,000, enlarging and extending their plant.

The National Self-Winding Clock Company, Champaign, Ill., is to erect four new buildings, in addition to its present plant. These are to include an enameling shop, 30x65 feet; a molding room, a foundry and a blacksmith shop.

The United States Supply Company, Chicago, Ill., has let the contract for a factory about to be built at 1035-43 West Thirty-fifth street, after plans by Jarvis Hunt. The building will be two stories high, 100x125 feet in size, of brick and stone, and will cost $35,000.

Fire has destroyed the foundry and two buildings of the Scranton Steam Pump Company, Scranton, Pa., causing a loss of $150,000. The factory of the Schmidt & Ault Paper Company, York, Pa., located at York, was also destroyed by fire, causing a loss of $65,000.

The plant of the Crescent Manufacturing Company, Spartanburg, S. C., hosiery and underwear manufacturer, will be enlarged in the near future, for additional machinery will be purchased at an early date and installed in the mill. The decision to purchase additional machinery was made at a meeting of the directors of the company, held at the office of President D. D. Little. He was authorized to take up the matter at once. The plant will be increased to 140 machines.

New Catalogues.

De La Vergne Machine Company, New York. Folder descriptive of the Koerting gas engine. Illustrated.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1102, showing the Westinghouse direct-current multiple arc lamp.

O. S. Walker & Co., Worcester, Mass. Catalogue "G," descriptive of the Walker magnetic chucks and grinders. 6x9, pp. 30. Illustrated. Heavy coated paper.

The Cincinnati Shaper Company, Cincinnati, O. Catalogue "D," descriptive of the various types of shapers manufactured by this company. 6x9, pp. 47. Illustrated.

Diamond Saw & Stamping Works, Buffalo, N. Y. Catalogue No. 12, descriptive of the

"Sterling" hacksaw blades, frames and power machines. 6x9, pp. 16. Illustrated.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 50, on Northern spherical machines. Shows standard dynamos and motors and the modifications of these frames.

Morgan Construction Company, Worcester, Mass. In a comprehensive and well-illustrated catalogue, entitled "Morgan Continuous Gas Producer," the merits of this producer are set forth, together with much instructive information regarding the process itself and the economies obtainable by its use as a modern means of securing the highest heating value of fuel.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Two steam turbine experts wish to interest a good machine concern or capitalists for a design of their own. Box 477, AM. MACH.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

Wanted—Immediately, geared drawing press; throw 5 in., and sufficient size to take die 24x20 in.; closed height, 5½ in.; state condition, make and price. Box 464, AM. M.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—Manufacturer to build patented small apparatus with established trade; must be equipped to make highest grade work; from $2,000 to $4,000 monthly at present. Box 455, AMERICAN MACHINIST.

For Sale.

One No. 2 Farwell milling attachment for planer made by The Adams Co., Dubuque; never used. The Miller, DuBrul & Peters Mfg. Co., Cincinnati, O.

Machinist having small machine shop, plenty of orders, on account of sickness, desires to sell, or secure an active partner; no agents. Box 476, AMERICAN MACHINIST.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

For Sale—At a bargain, drawings, patterns and special tools for line machine tools; also large quantity finished and partly finished parts of machines. Address "Receiver," care AMERICAN MACHINIST.

For Sale—An up-to-date manufacturing shop, located in Manhattan, New York city, suitable for inventor, general machine, experimental work or manufacturing; first-class machinery; electric power; large assortment fine tools; foreign and domestic trade; patents, stock, good will, or plant alone; reasonable. Address Box 442, AMER MACHINIST.

Business Opportunities.

Machinists who can take financial interest in shop write to Box 446, AMER. MACH.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value shoud not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

NEW JERSEY.

Assistant superintendent, age 27, draftsman, practical knowledge of drop forge and machine business, wants position in large field where opportunity is afforded. Box 474, AMERICAN MACHINIST.

Draftsman; technical, practical; well acquainted with tools, jigs and fixtures; 10 years' shop and drawing experience and 4 years as shop foreman; also well acquainted with electricity Box 456, AMER. MACH.

First-class designer, with shop experience, desires position as chief or leading draftsman; wide experience on high-grade work; small, up-to-date concern in Middle West preferred. Address Box 478, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 452, AMERICAN MACHINIST.

Mechanical draftsman, quick detailer, neat tracer, wants position. Box 487, AM. MACH.

Mechanical engineer (27); experience in gas and steam engine design. Box 475, A. M.

Machinist, die and tool maker, with large experience; good draftsman; capable of taking charge. Box 457, AMERICAN MACHINIST.

Millwright and carpenter desires to make a change; competent man, good machinist and experienced in handling men. Address "Foreman," Box 475, AMERICAN MACHINIST.

Manager's assistant or superintendent (40), in factory or electrical or other goods; systematizing for costs, indexing, filing copy for catalogues and advertisements. Box 479, AMERICAN MACHINIST.

Mechanical engineer (34), practical toolmaker, expert designer of automatic machinery and experienced in organizing for production on modern lines, desires change. Box 411, AMERICAN MACHINIST.

Situation as superintendent or general foreman; age 30; 15 years' experience on repairs, tools, special machinery, cranes and elevators; good executive ability; at present foreman in large concern; references. Box 468, AMERICAN MACHINIST.

MASSACHUSETTS.

Superintendent, age 37; 20 years on gun, typewriter and electrical instrument work; accustomed to exceedingly close limitations; methods and system most modern Box 459, AMERICAN MACHINIST.

Toolroom or general foreman position wanted by technical, experienced toolmaker on modern tools, jigs and high-speed steels; cost-reducer with good executive ability; that's all. Box 484, AMERICAN MACHINIST.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

Strictly high-grade, brainy mechanic desires executive position, perfecting or manufacturing products. Box 441, AMER. MACH.

Mechanical engineer and expert designer, with long and varied experience, Corliss engines, power transmission, gas engines, is open for engagement; competent to take charge, and accustomed to the control of men. Box 485, AMERICAN MACHINIST.

Man with 15 years' experience as designing draftsman, machinist and operating engineer of steam and electrical machinery, wishes to leave present position for one with live, progressive firm; have had charge in shop and office. Box 486, AMERICAN MACHINIST.

Wanted—After Sept. 1, a position as superintendent or assistant, where the services of a man of exceptional executive ability and an all-around, A1 draftsman, toolmoker and machinist on intricate and accurate work will be appreciated; a perfectly competent designer and builder of special and automatic machinery; sober, honest, reliable and non-union; Middle West preferred. Address W. G. Y., care AMERICAN MACHINIST.

PENNSYLVANIA.

Wanted—Position by experienced steam turbine designer; graduate engineer with wide experience. Address "Turbine," care AM. M.

Capable man, practical machinist by trade and experienced in the manufacture of metal goods, well educated and of fine address, now in position requiring technical and business executive ability, would take a step upward. Box 437, AMERICAN MACHINIST.

Competent electrical and mechanical engineer, college graduate, with 10 years' experience in shop, drafting room and as central station manager, at present electrical engineer with large steel works, desires change; can furnish best of references. H. M., care AMERICAN MACHINIST.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 436, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Machinists upon lathes and grinders. Address Bantam Anti-Friction Co., Bantam, Conn.

Wanted—Three first-class toolmakers, capable of doing small, accurate work; men experienced on a fine class of watch factory die work preferred. Apply Veeder Mfg. Co., Hartford, Conn.

ILLINOIS.

Wanted—Gang foreman for large locomotive plant; state experience, age, references and salary expected. Address Box 481, A. M.

Wanted—Foreman pipe-fitter; must be thoroughly familiar with locomotive and car work; state age, experience, references and salary expected. Address Box 483, AM. M.

Wanted—Machine and tooroom foreman for large locomotive plant; must be thoroughly familiar with modern high-speed tools; state age, experience, references and salary expected. Address Box 482, AMER. MACHINIST.

Wanted—An experienced, energetic and competent factory superintendent, trained to fine work, who will become financially interested in the company; this is an unusual opportunity, as the company is young, thoroughly equipped, and has an assured future. America Co, Rockford, Ill.

Wanted—Expert drop forge die and tool designer on medium work, by large manufacturing concern; must be thoroughly posted on modern shop methods, with ability to handle men; in answering, state full particulars; no applicant will be considered whose record does not prove him to be of the highest grade. Box 463, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

KENTUCKY.

Wanted—Mechanical draftsman and patternmaker, to make detail working drawings and work at patternmaking when not needed in drafting room. Hagan Gas Engine & Mfg. Co., Winchester, Ky.

MARYLAND.

Machine tool traveling salesman of experience wanted; must be well posted on metal planing and drilling machinery; salary and commission given. Address "Planer," care AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—First-class toolmaker; state experience, wages expected. Box 460, AM. M.

One draftsman, one planer hand, two machinists of first class and accustomed to finest machinery; state experience; reference is required. Box 471, AMERICAN MACHINIST.

Wanted—First-class machinists for Jones & Lamson turrets, planers, drills, vise work, floor work; steady work; good wages. Apply to Campbell Printing Press & Mfg. Co., Taunton, Mass.

Wanted—A young man with a technical education (Mass. Ins. Technology preferred), who understands principle, and with a practical knowledge of gas engines; shop located in eastern Massachusetts; send references and further information; a good opening for a young, ambitious man. Box 472, AM. MACH.

MISSOURI.

Wanted—A1 man to take charge of automatic screw machine department; Brown & Sharpe make; permanent position to right man. Box 473, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—Draftsmen with experience on wire covering machinery; reply, stating experience and pay expected. Box 466, AM. M.

Wanted—Salesman or manufacturer's agent; must be thoroughly familiar with engine packings and mill supplies; state experience, reference and salary expected. Box 402, AM. M.

Wanted—Machinists familiar with vise work and erecting stationary engines and air compressors; give age, experience and previous employment. Address Box 458, AM. M.

Wanted—Near New York, experienced milling machine operator to take charge of machine tool work; one acquainted with interchangeable system. Address Box 465, A. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

First-class draftsman, erectors, boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Foreman, capable of running and enlarging small machine shop; excellent opportunity for a good man. Apply, stating salary and references, "Capable," care AMER. MACHINIST.

Wanted—Several first-class mechanical draftsmen; must have had technical training and be thoroughly practical, rapid and accurate. Address Box 480, AMER. MACHINIST.

Several draftsmen wanted by large concern in New York city; steady employment to suitable men; state age, experience, salary and two business references. Box 419, AM. MACH.

Wanted—Experienced milling machine hand to take charge of gang of milling machines and shapers; give experience and references; state wages desired. Address "25 W.," care AMERICAN MACHINIST.

Wanted.—A first-class opportunity is open for a salesman who knows steel and its users, tempering liquids and oil for Novo steel, welding compound and slush oil. Box 470, AMERICAN MACHINIST.

Wanted—Experienced man in engineering department of elevator works for specifying and listing material from "Layouts" and making sketches; state age, experience and salary expected. Address Box 451, AMER. MACH.

A good business man, also another more technical man, desired for large, solid iron and steel company; investment required, $5,000 to $15,000, secured to satisfaction; right salaries. Address Box 461, AM. MACH.

OHIO.

Wanted—Draftsman; preferably one with some experience in engineering specialty line; give experience in detail and salary expected. Address P. O. Box 876, Cincinnati, O.

Wanted—A man of experience and ability in the manufacture of portable well-drilling machinery or similar work; give age, experience, reference and salary expected. Box 467, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted at once at steel works in Eastesn Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—First-class designing draftsman; must have experience in air compressor or engine work; give age, experience and salary expected. Address Box 469, AMER. MACH.

Wanted—At once, a number of first-class machinists, experienced in machine and floor work on engines; good wages and steady employment to first-class men. Jacobson Machine Mfg. Co., Warren, Pa.

Wanted—Several good Corliss engine erectors and several fitters and floor hands; also one first-class journeyman patternmaker on Corliss engine work; highest wages to good men. Scottdale Foundry & Machine Co., Scottdale, Pa.

RHODE ISLAND.

Toolmakers wanted; first-class workmen, experienced on jig and fixture work, for light high-grade machinery Call or address, The Taft-Pierce Mfg. Co., Woonsocket, R. I.

UTAH.

Wanted—One first-class mechanical draftsman for general mine and smelter work; good position for man giving satisfaction; must be accurate and make neat drawings; application to state all particulars. Box 462, AM. MACH.

WEST OF MISSISSIPPI.

Wanted—Foreman for machine shop located in Western town; class of work, hoisting engines. Address, with reference, "O.," care AMERICAN MACHINIST.

Wanted—Six good gas engine engineers, familiar with operating large engine plants; good salary to right men; give experience and reference. Box 426, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Mechanics to design and construct parts for automobiles; competent men can have steady positions, with prospects for advancement. Address Thomas B. Jeffery & Co., Kenosha, Wis.

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Dixon Crucible Co., Jos., Jersey City, N. J.
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Schieren & Co., Chas. A., New York.
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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

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Hilles & Jones Co., Wilmington, Del.
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Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer

New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

Chains, Driving

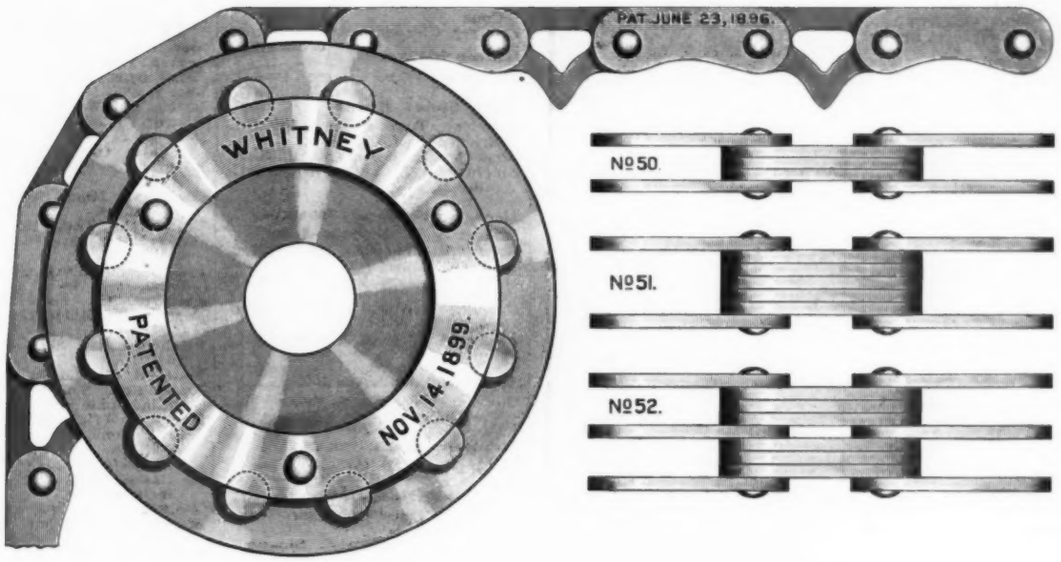
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines

American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.,
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.



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Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

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Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

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Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

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Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Coburn Trolley Track Co., Holyoke, Mass.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

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Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Bolt
Brown Co., H. B., Easthampton, Conn.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Huribut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

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Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

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Universal Drafting Mach. Co., Cleveland, O.

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Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

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American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Morton Machine Tool Wks., Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

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Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
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Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

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McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
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Marshall & Huschart Mchry. Co., Chicago, Ill.
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New Haven Mfg. Co., New Haven, Conn.
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Prentiss Tool & Supply Co., New York.
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Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Pratt & Whitney Co., Hartford, Conn.
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Standard Tool Co., Cleveland, O.

Drills, Pneumatic
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Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

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Crocker-Wheeler Co., Ampere, N. J.
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BROWN & SHARPE MFG. CO.,

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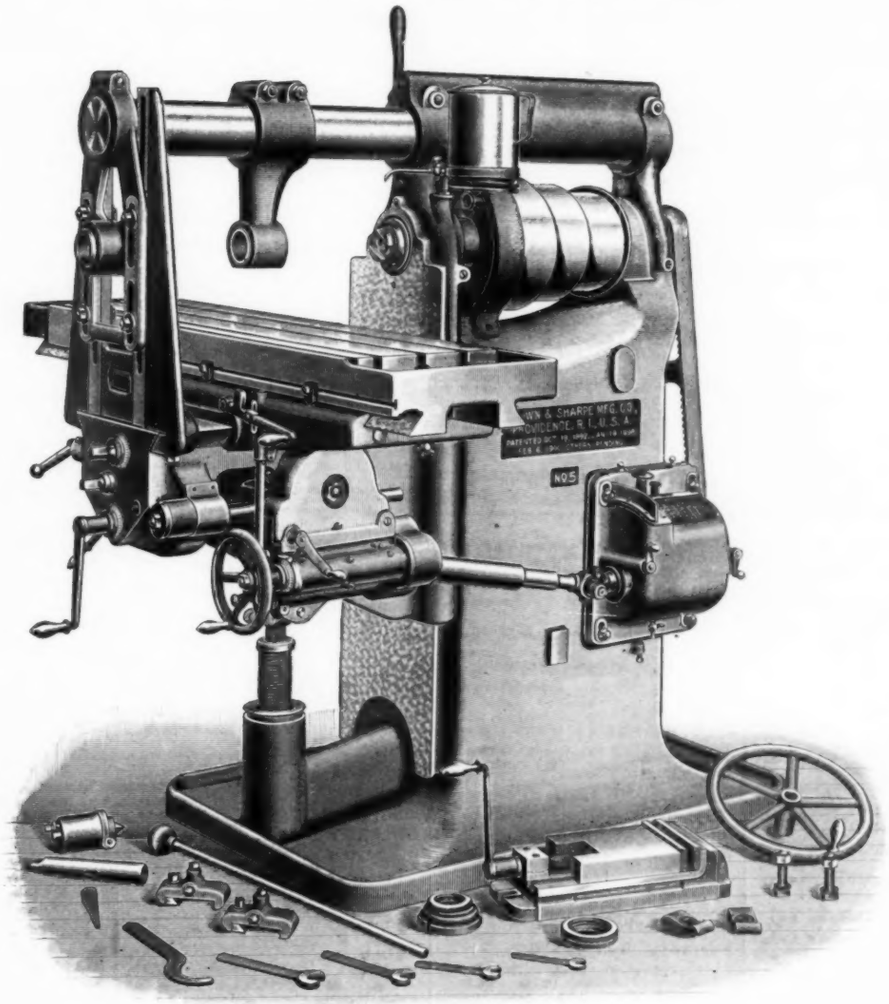

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Ample Driving Power. Will carry any cut within the capacity of the machine.

Large Bearing Surfaces. Insure accuracy and maintenance of alignment.

All Levers and Hand Wheels arranged for most convenient manipulation. 300 of them in almost constant operation throughout the plant. This practical experience may be of service to you. Send sketch or sample of work and we will be pleased to submit estimates.

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Roth Bros. & Co., Chicago, Ill.
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See Grinding Wheels.

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Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

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Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
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Crescent Forgings Co., Oakmont, Pa.
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Wyman & Gordon, Worcester, Mass.

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Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

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American Gas Furnace Co., New York.

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New Britain Mach. Co., New Britain, Conn.

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Starrett Co., L. S., Athol, Mass.

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Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

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Philadelphia Gear. Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

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Nuttall Co., R. D., Pittsburg, Pa.
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Simonds Mfg. Co., Pittsburg, Pa.
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Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

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Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

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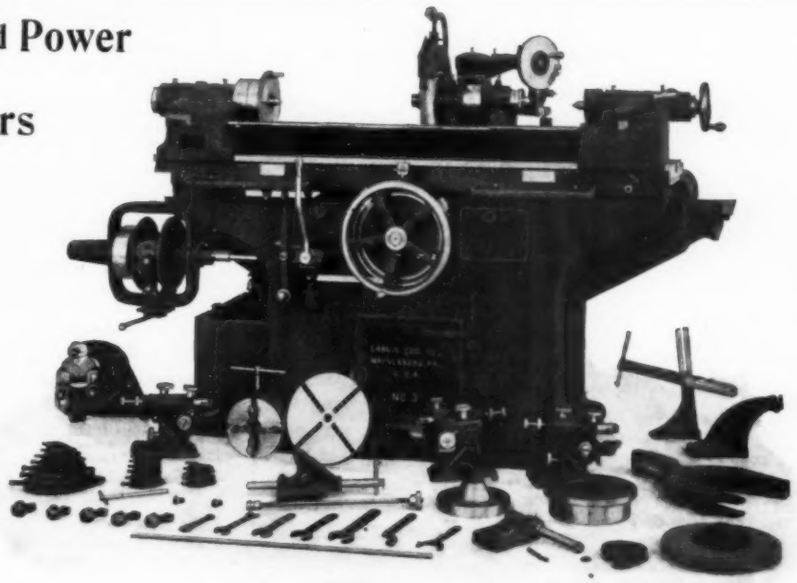
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.

Strength, Rigidity and Power of the Landis Grinders

It required many years of manufacturing and experimenting before we succeeded in getting a proper distribution of weight to resist vibration. As a result, however, vibration has been reduced to a minimum and our grinders will handle anything that can be revolved on dead centers easier, faster and more economically than any other grinder known to the trade. They have an abundance of power, and their speed and working capacity are truly remarkable. A degree of accuracy within .0001" of perfection can be obtained.



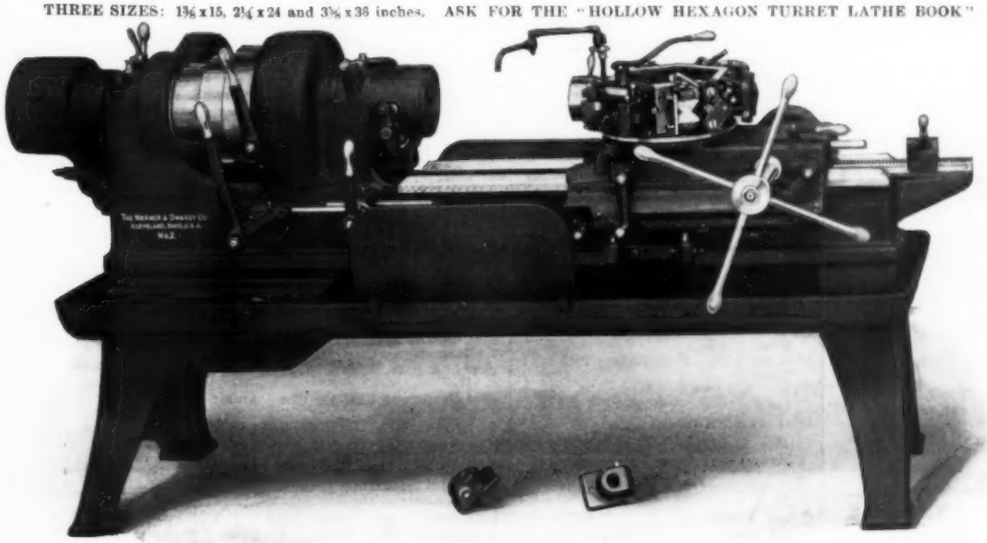
No. 3 Universal Grinder, 12" Swing, 42" Between Centers.

Landis Tool Co., Waynesboro, Pa., U. S. A.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty Street, New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Modern design—rigid construction—ample power—wide range of speeds and feeds—complete tool equipment. Adaptability—rapidity—accuracy

THREE SIZES: 1⅜ x 15, 2¼ x 24 and 3⅜ x 36 inches. ASK FOR THE "HOLLOW HEXAGON TURRET LATHE BOOK"



No. 2—2¼ x 24 inches.

Turret Lathes, Screw Machines and Brass Working Tools

THE WARNER & SWASEY CO., CLEVELAND, OHIO, U.S.A.

FOREIGN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg and Stockholm. A. H. Schutte, Cologne, Paris, Brussels and Milan. H. W. Petrie, Toronto. Williams & Wilson, Montreal.

Grinders, Tool —*Continued*
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.

Hammers, Drop—*Continued*
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Pryibil, P., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Mon-
International Steam Pump Co., New York.
tour Falls, N. Y.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Street Bros. Machine Co., Chattanooga, Tenn.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Machine Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.

Lathes—*Continued*
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Silk Mach. Tool Co., P. P., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Bancroft, Sidney, New York.
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.

The Nordberg Static Governor.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show a governor for pumping engines and air compressors, which has been applied to numerous engines of that class by the Nordberg Manufacturing Company, of Milwaukee, Wis., and which, to the best of my knowledge, introduces an entirely new principle, this principle being the control of the speed through a wide range by a centrifugal governor, the pressure

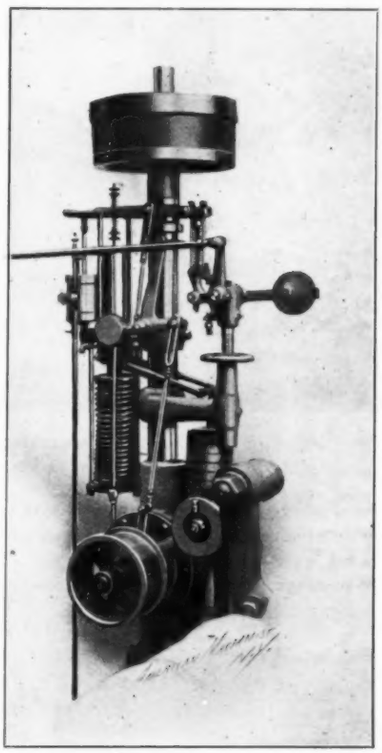


FIG. 1. THE NORDBERG STATIC GOVERNOR.

governor serving to indicate to the centrifugal governor if the speed is too high or too low for the required pressure, but doing no more than this.

The usual combination for an air-compressor governor consists of a centrifugal governor of the usual type—that is, one which is as sensitive as possible without being unstable, the only intended office of this governor being to limit the speed of the compressor at its highest intended rate, while the actual control of the speed at all lower rates is, by intention at least, obtained from the pressure governor, which is so arranged as to shorten the cut-off as the air pressure increases and *vice versa*.

As a matter of fact, few of these governors act as intended. The variation of the air pressure is, of course, kept as small as possible, the effect upon the indicator card from the air cylinder being practically negligible and such effect as exists being in the contrary direction to that produced on the steam card—a lowering of the air pressure and a reduction in the area of the air card being followed by a lengthening of the cut-off and an increase in the area of the steam card. The purpose of the lengthening of the cut-off is, of course, to increase the speed in order to prevent further fall of the air pressure and the increased cut-off desired is only that necessary to meet the increased friction work due to the higher speed—an increase that is, of course, very small.

Under these conditions the real action is that under a decrease of air pressure the cut-off is lengthened and the speed is increased to the upper limit, where the centrifugal governor assumes control while under an increase of pressure the cut-off is shortened until the speed decreases to its lower limit, the speed constantly alternating between these two extremes.

With the Nordberg governor the speed is at all times under the control of the centrifugal governor, which maintains the speed at whatever rate between the lowest and the highest may be necessary to preserve the air pressure constant at the point then existing—a reduction of the pressure leading to an increase of speed and *vice versa*, this increase or decrease being again such as will maintain the pressure at the new point. In other words each pressure between the narrow limits set in the design of the governor has its appropriate speed, which is of course the ideal condition.

To accomplish this result the centrifugal governor, instead of being as sensitive as possible, is extremely insensitive. It is not to be understood from this that it is sluggish in action, but that it is so designed that the ratio between the speed at which the balls begin to move outward and that at which they complete the outward movement is a large one, so large, in fact, as to cover the entire range of

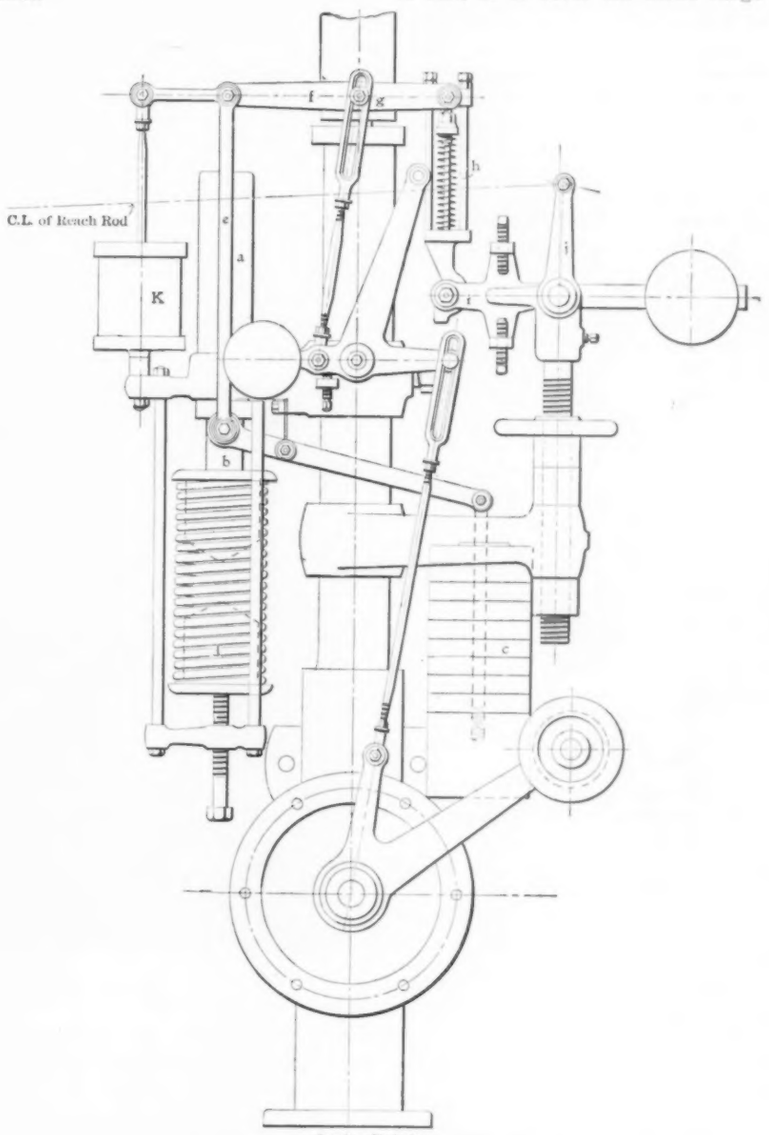


FIG. 2. THE NORDBERG STATIC GOVERNOR.

speed under which the compressor is intended to operate. That is, with the balls in their inner position, the governor will give to the engine its slowest speed, and in order to expand the balls to their outermost position the speed must be increased to its highest rate, the ratio between these speeds being, for an air compressor, perhaps, 4 to 1. Those readers who are familiar with the principles of governors will not need to be told that such a governor is exceedingly stable, and hence its name "static."

The general appearance of the combined centrifugal and pressure governor is shown in Fig. 1, while its construction is more clearly shown in Fig. 2, from which the revolving ball case is, however, omitted. The two illustrations differ slightly, but only in unimportant details.

The pressure cylinder, which is inverted, is at *a*. The plunger *b* is loaded partly by a weight *c* and partly by a spring *d*, the office of the spring being to provide a slightly increasing resistance as the plunger is forced out of the cylinder. Supposing the demand for air to increase and the pressure to drop, the effect is a rise of the plunger in its cylinder, the bridle link *e* (of which there are two, one each side of the cylinder) raising the lever *f*, which is pivoted to the centrifugal governor collar at *g* and connected to the cut-off reach-rod by the link *h* and levers *i j*. The centrifugal governor being, by its design, extremely stable, the fulcrum pin *g* remains stationary under this action and the rise of the plunger thus depresses *h* and lengthens the cut-off, giving momentarily an increase of steam to the cylinder under which the engine accelerates in speed. Under this increase the centrifugal governor balls expand, raising the collar pin *g* and the link *h*, thus shortening the cut-off to nearly the former point, the speed settling down to that corresponding to the new position of the balls, at which point it will remain until another change in the air pressure is followed by a similar action.

At *k* is a dash pot, and the usual safety features are also added. These are sufficiently obvious from the illustrations and need not be described.

F. A. H.

The contract for two turbine steamships for passenger service between New York and Boston has just been let to the Roach Shipbuilding Company, of Chester, Pa., by the Metropolitan Steamship Company, of New York. These vessels will be about 400 feet long, and each will be driven by three turbines aggregating 10,000 horse-power. The speed will be about 20 knots, and the cost of each ship over $750,000. These will be the first turbine steamers for coastwise service built in this country.

A "Llestr" of lime in Carnarvonshire, equals 1 bushel.

The New Works of the Ingersoll-Sergeant Drill Company at Phillipsburg, New Jersey—III.

The present instalment of our description has to do with the air-compressor building and erecting shops, and Fig. 27 is another view from the top of the chimney, this time looking south and showing one of the compressor shops nearly finished. The erection in the foreground is the lean-to portion of the compressor erecting shop, the principal and higher portion of the building to occupy the space between these two erections shown being not then erected.

Moving directly backward from the lean-to in the foreground of Fig. 27, through the wall and out into the yard, we are in position for the view in Fig. 28, which shows a corner of the completed compressor building, a corner of the power house at the left, and in the middle the tank of the air-lift pump which supplies the entire works with drinking water. The pump is in operation constantly, or as nearly so as may be required to keep the tank nearly full, its action being automatically controlled by a float in the tank. The water is allowed to flow constantly from faucets conveniently located in the different shops. It is cold and clear, is an admirable drinking water, and is highly appreciated by all the employees of the works.

Fig. 29 is the general construction drawing of the compressor buildings, which can be studied with profit, but requires little remark.

In the half-tone, Fig. 30, we have stepped into the building again and are looking from under the lean-to across the main erecting shop, and at the left we look down through one of the compressor machine shops before many of the tools were placed. Up at the right we see a portion of the 40,000-pound traveling crane, and on the floor under it is a large hydraulic wheel press. Behind the wheel press is the large bay window of the superintendent's office, which projects out sufficiently to give a clear view of the entire interior of the shop.

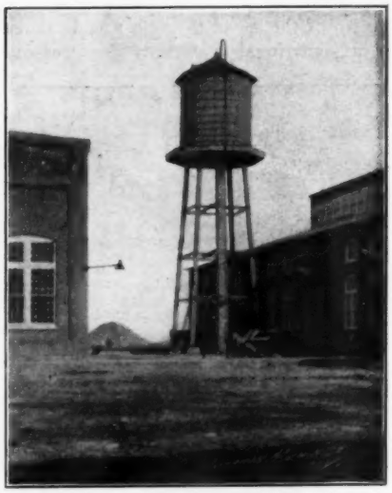


FIG. 28. THE TANK OF THE AIR-LIFT PUMP.

In Fig. 31 we have stepped into the middle of the shop near the east end and looking west. At the left we see one of the runways for the traveling crane of compressor machine shop No. 10, while in the middle of the picture project the similar runways of machine shop No. 9. At the right in the distance project the runways for the crane which traverses the storage and shipping department. These runways are all at the same height

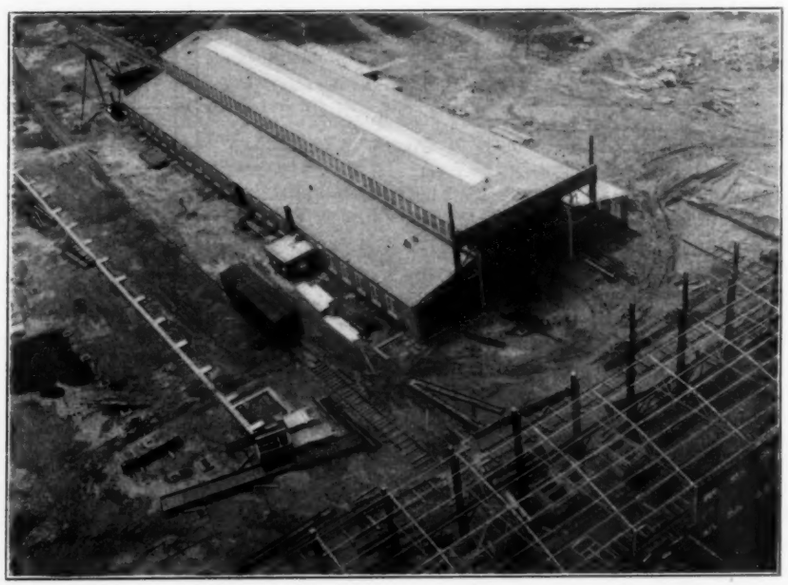


FIG. 27. ERECTING THE COMPRESSOR SHOPS.

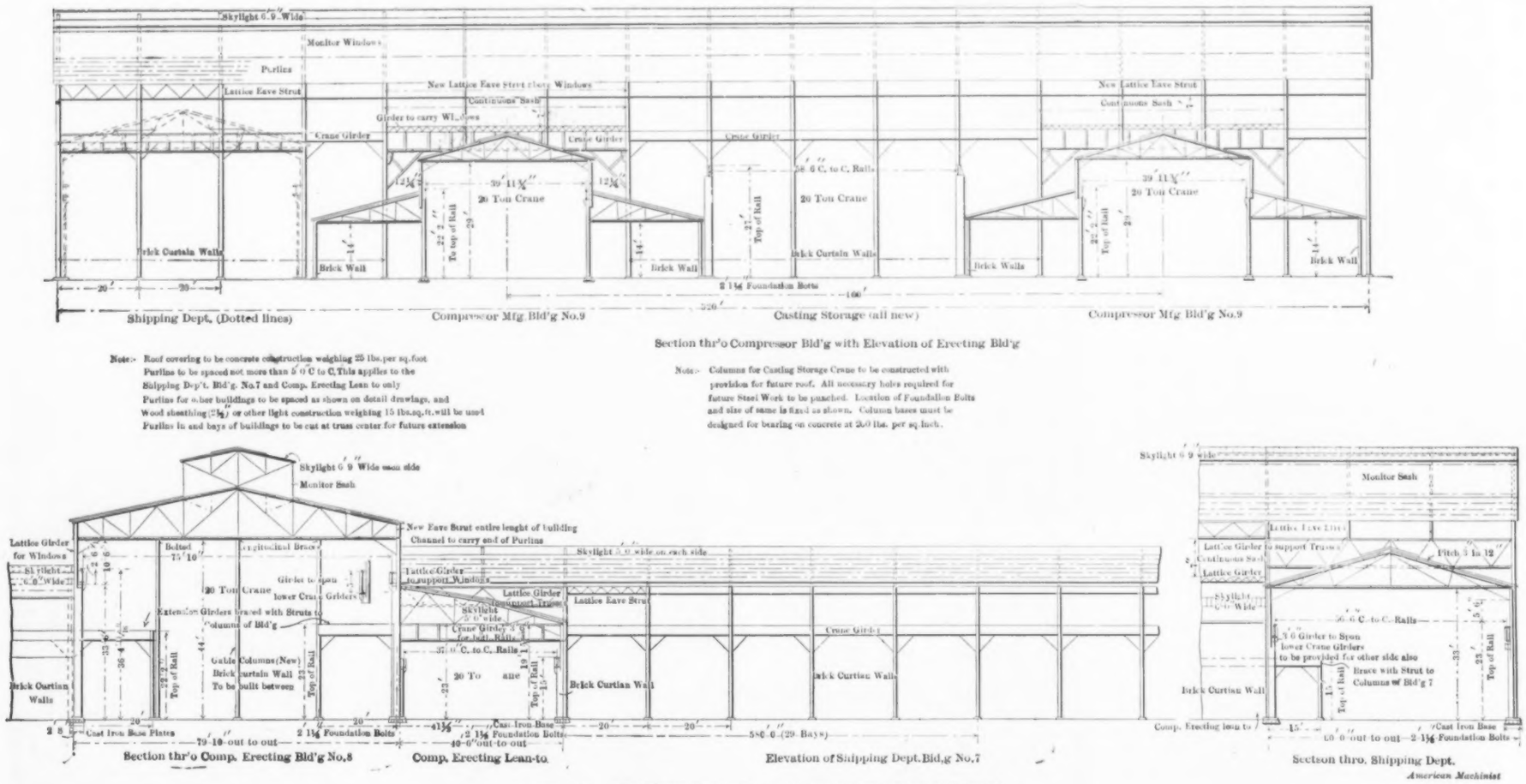

Skylight 6'9" Wide
Monitor Windows
Purlins
Lattice Eave Strut
New Lattice Eave Strut entire lenght of Windows
Continuous Sash
Girder to carry Windows
Crane Girder
39'11¼"
20 Ton Crane
58'6" C. to C. Rails
Brick Curtain Walls
Brick Wall
Brick Walls
2 1¼ Foundation Bolts
Shipping Dept. (Dotted lines)
Compressor Mfg. Bld'g No.9
Casting Storage (all new)
Compressor Mfg Bld'g No.9
Section thr'o Compressor Bld'g with Elevation of Erecting Bld'g
Note:- Roof covering to be concrete construction weighing 25 lbs. per sq. foot
Purlins to be spaced not more than 5'0" C to C. This applies to the Shipping Dep't. Bld'g. No.7 and Comp. Erecting Lean to only
Purlins for other buildings to be spaced as shown on detail drawings, and Wood sheathing (2½") or other light construction weighing 15 lbs. sq. ft. will be used
Purlins in end bays of buildings to be cut at truss center for future extension
Note:- Columns for Casting Storage Crane to be constructed with provision for future roof. All necessary holes required for future Steel Work to be punched. Location of Foundation Bolts and size of same is fixed as shown. Column bases must be designed for bearing on concrete at 350 lbs. per sq. inch.
Skylight 6'9" Wide each side
Monitor Sash
New Eave Strut entire lenght of building
Channel to carry end of Purlins
Lattice Girder for Windows
Bolted
Gritticical Brace
20 Ton Crane
Girder to span lower Crane Girders
Extension Girders braced with Struts to Columns of Bld'g
Gable Columns (New) Brick Curtain Wall To be built between
Brick Curtian Walls
Cast Iron Base Plates
79'10" out to out
Section thr'o Comp. Erecting Bld'g No.8
Lattice Girder to support Windows
Lattice Girder to support Trusses
Lattice Eave Strut
Skylight 5'0" wide on each side
Crane Girder
Brick Curtian Wall
2 1¼ Foundation Bolts
40'6" out to out
Comp. Erecting Lean-to
Cast Iron Base
20
20
580'6" (29 Bays)
Elevation of Shipping Dept. Bld'g No.7
Lattice Eave Strut
Lattice Girder to support Trusses
Continuous Sash
Lattice Girder
Pitch 3 in 12
56'6" C. to C. Rails
3'0 Girder to Span Lower Crane Girders to be provided for other side also
Brace with Strut to Columns of Bld'g 7
Top of Rail
Comp. Erecting lean to
Cast Iron Base
40'0" out to out
2 1¼ Foundation Bolts
Section thro. Shipping Dept.
American Machinist

FIG. 29. CONSTRUCTION DRAWING OF COMPRESSOR BUILDING.

and all low enough for the big crane to travel over them without interfering. The entire floor is thus commanded by the cranes. In the extreme distance are seen two railway cars, the track for them extending to the right all through the shipping department and out through the other end.

In Fig 32 we are looking north through the shipping and storage department. This building has since been filled with compressors and parts at this end, and with drills and mining machinery at the other end. As the contents of this building will normally consist largely of goods packed in boxes, the liability to fire is greater than elsewhere, and the entire roof is accordingly equipped with automatic sprinklers placed at frequent intervals.

Fig. 33 is a plan of the compressor-erecting floor, which has been laid out and equipped with pits, piping and foundation plates for the different styles and sizes of compressors to be erected.

Fig. 34 shows the construction of the pits with some of the foundation plates in position. The ledges in the concrete walls will be noticed for placing planking convenient for the men to work on. Much of the piping later placed in the pits is not here shown. In this view we see more clearly the superintendent's window, and also can see the entire length of machine shop No. 9. In this picture the floor is evidently in an unfinished state, and it is to be remembered that now that the shop is complete none of the pits are left open, except as required for actual use, the others all having suitable covers to make a perfectly level floor. There are machinists' benches all around the erecting shop with 50 heavy vises, and all the hand work connected with the building of the compressors is done here. In the shops where the machine work is done there are no benches or vises, except at one end of one of them.

We may now feel at liberty to walk

around a little and look at a few things at short range. Fig. 35 is in the northeast corner of the erecting shop and shows an engine and pulley frame for driving belt-driven compressors. The compressor is at the left, while the halves of its pulley are on the floor at the right. In Fig. 36 we are in the middle of the erecting shop, where a large duplex compressor is being assembled. In Fig. 37 we have walked around to the door of the office of Mr. Fruchi, the superintendent of the compressor department, and we get an idea of the view of shop matters from the large bay window. The office is large and roomy and well lighted, though not, of course, lighter than the shops are at all points.

A large number of the machines have had motors attached to them by the electricians of the company. In most cases it has been necessary to devise and attach brackets to the machines, to supply auxiliary shafts, gears, etc. These things will mostly speak for themselves in the views here shown without detailed explanation. In Fig. 39 we are looking across the tops of some lathes at the backs of two electric-driven radial drills, and in Fig. 40 we see the front of the row of drills. Fig. 41 shows the mode of mounting the motors on large lathes, say, 36- to 48-inch swing. Fig. 42 is a large horizontal boring mill with motor, and Fig. 43 shows the motor drive of a vertical boring mill. In the motor driving of planers, as in Fig. 44, it is found a great help to use heavy flywheels on the motor shaft. Belting from this directly to the machine pulleys makes a very simple drive.

Fig. 45 shows the yard between the two compressor machine shops and looking toward the machine shop. The entire yard is commanded by the traveling crane, the railway track runs into the compressor-erecting building and there are two cross tracks running into both the buildings at the sides. R.

FIG. 30. LOOKING ACROSS THE ERECTING SHOP.

In Fig. 38, which shows the base of a large radial drill with the controller attached, there are two or three things to be noticed. At the top is seen a little plate attached to the frame. This is the Ingersoll-Sergeant plate with the shop or record number of the machine, every machine throughout the works having its own number under which it is recorded in the books—or, rather, cards—in the office. Below this is seen a pocket, also common to nearly all the machines, for the workman's job or time card. At the bottom is seen an iron pipe coming up from the floor. The electric cables after leaving the subway are carried under the floor in vitrified conduits and then are led through these iron pipes into the machines, there being no exposure of the wires at any point.

A "hobbet" of old potatoes, in Flintshire, equals 200 pounds. A "hobbet" of new potatoes, in Flintshire, equals 210 pounds.

Echoes From the Oil Country—A Sawmill Job.

"Sammy, they have one of our engines out at a sawmill near here. They think something is the matter with the inside of the cylinder, the rings are broken or something. They started to take it apart and find that they can't get the piston rod screwed out of the crosshead. Here is the hacksaw and an extra blade. Go out along with this man and saw the piston rod in two and get the head out. Bring it and the crosshead in and we will fix them up again. Get a move on, for they are in a hurry to get going again, and take a pair of insides with you to see if the cylinder is much out of shape."

It was a beautiful day to stay in the shop. Outside the snow was having things much its own way, for it was a regular blizzard, and from the way the wind was blowing it was very plainly to be seen that the roads would be drifted. Many a time Sammy had wished that the foreman would come along and send him out somewhere, just for a change, but that was not in this kind of weather; however, this was the day selected and here was a man, wrapped in a big storm coat, waiting for him.

"Where is the mill?" he asked.

"It's not so very far; just up the road a ways," the man replied.

Sammy had some recollection of a job that he started for one evening that was

FIG. 31. ERECTING SHOP, LOOKING WEST.

FIG. 32. SHIPPING AND STORAGE, LOOKING NORTH.

"out in the country a piece," when it took the team six hours to go the "piece," but he bundled a few tools together and slid into the old ulster without taking off his overclothes. He had gone without his overcoat the other time and thought he would freeze before getting there.

"Lucky Sammy, going for a nice little sleigh ride this beautiful day," sang out one of the men in derision as Sammy started out, trying to look honored and important.

"Sammy must have a pull somewhere," joined in another.

"The boss knows some fellows which he dassent let get out of his sight," Sammy flung back at his tormentors.

"Shut that door, you young whelp; do you think this is a sawmill?" yelled a cold-blooded individual, as he reached for something he could throw. Sammy climbed into the cutter and was soon bumping along through the drifts. The sawmill was not so very far away, and the driver was in a hurry. He was the owner of the mill and all the talking that he did was to let Sammy know that he was in a hurry. The mill men were paid by the month and he did not want any more stopping time if it could be avoided.

Sammy found that they had succeeded in screwing the piston rod about halfway out of the crosshead before it had stuck. They told him that it had seized in the threads and wanted him to get right at the sawing.

Sammy had seen a lot of those piston rods turned up, and he knew that the steel in them was hard and he knew that the hacksaws were none of the best and that it meant a lot of slow, hard work to get the rod cut through, and it also meant that he would feel disgraced if he discovered afterward that the rod could have been saved.

By trying to screw the rod first one way and then the other he found that he could move it a little, and he also found that it was not tight in the crosshead, for it did not even lift the crosshead so that it pressed against the top guide. He asked for one man to help him, and while the owner went to show the others some cleaning up they might do he had this man take the pipe tongs and move the rod a little while he tapped with his hammer on the head. Soon the rod stuck and he had the man back up a little while he continued the tapping, and then had him turn ahead again. After several trials of this he was sure that the rod was coming out, although it was but slow.

By the time the owner got back he had gained, perhaps, a full turn and found out that two or three more turns would be far enough to let the head come back so that the first pair of rings would drop into the counterbore.

"There isn't the least use of your wasting time fooling with that pair of pipe tongs," the owner said sharply, as soon

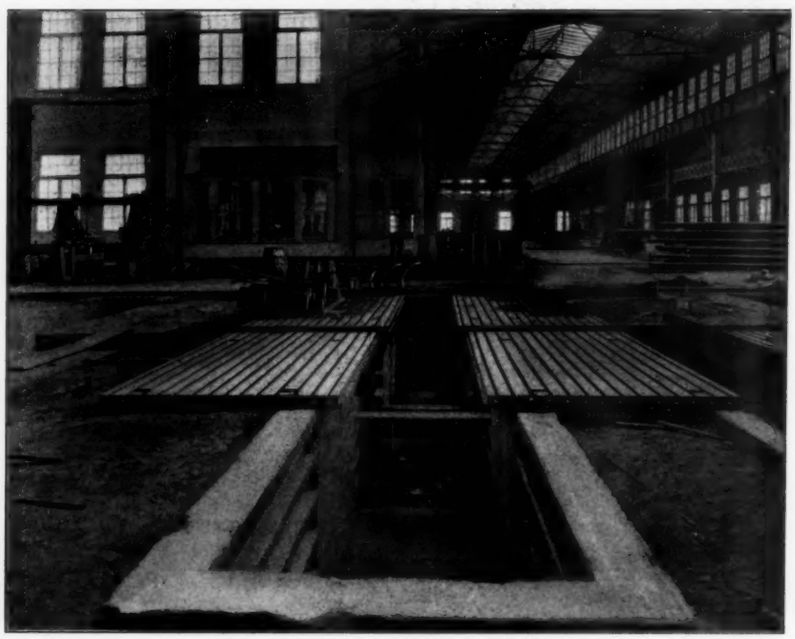


FIG. 34. WORKING PITS AND FOUNDATION PLATES.

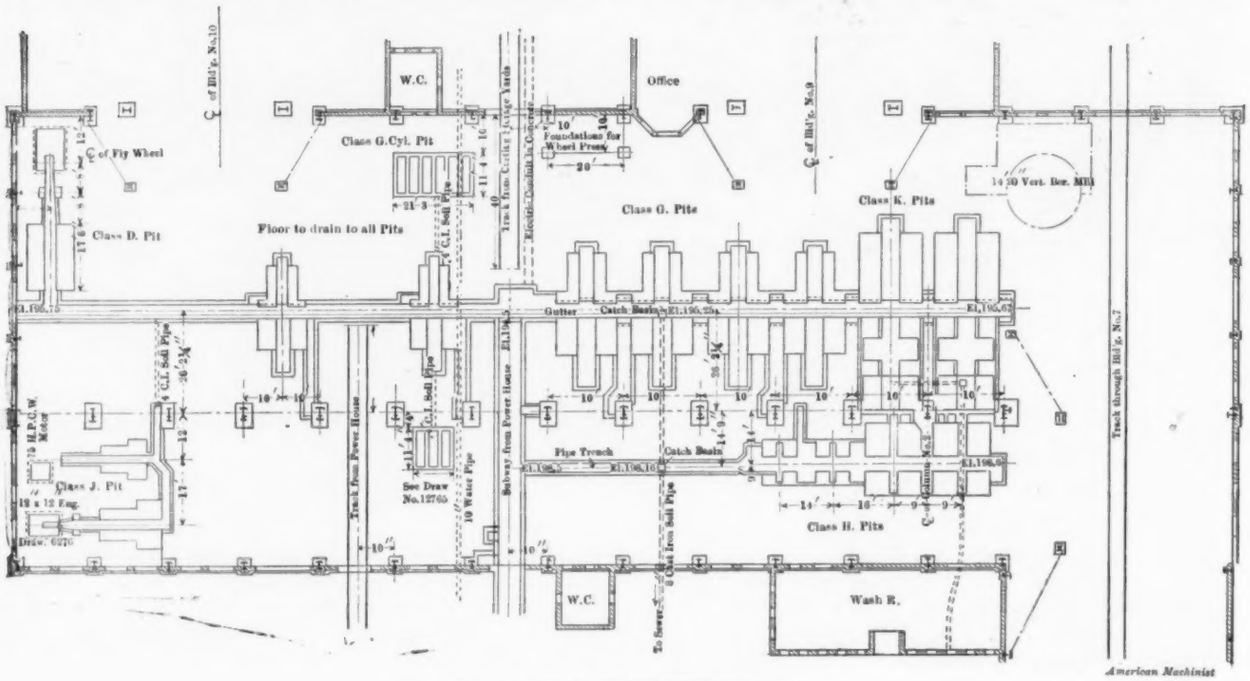


FIG. 33. PLAN OF ERECTING FLOOR.

as he saw that Sammy was not sawing at the rod. "If anyone could have screwed that rod out we would not have gone for you. They are going to keep a man at the shop to-night so that I can get going by morning, and I want that stuff back at the shop just as quick as it can be got there."

This man was a big burly fellow who was used to having his own way, and for a little bit Sammy had a mind to start sawing the rod, but it seemed to him that the turning was now a little bit faster than it had been at first. He kept nodding to his helper as he wanted him to turn and kept his hammer going as he made reply. "See here a minute, will you? Just you watch that mark on the head for a little and see how she is coming. Look at that, will you? It is around four or five degrees farther than it was when I began talking to you, and the first thing you know we will have it clear out, and then you won't have to get a new rod and maybe a new head."

But who ever saw a woodworker who thought that a job in iron was being done rapidly? and really this job was not being done at all quickly, but in Sammy's mind was the picture of rubbing a hacksaw on that piston rod, and working in a very awkward position, and, perhaps, losing a lot of skin from his knuckles. He knew *that* job would be even slower.

"You might live long enough to get that rod out that way, but I doubt it," said the owner.

"It only seems slow because you are watching it," said Sammy, in what he meant for a conciliating tone. "While you were away with the other men it seemed to come right along."

"Where did you put the hacksaw? I'll show you how long it will take to get that rod off."

Sammy had learned that it is a good thing to keep track of one's tools in a sawmill or other places where tools are much needed and scarce, and his bundle was down beside him well covered in the sawdust.

"I will be ready to try whether this thing won't come out in a minute, and as soon as I do I will hunt you up the hacksaw if you want it. It is lying around here some place. It must be, for I brought it with me, or, at least, I think I did," and he looked over toward a bench near by that was littered with odds and ends.

The owner walked over to the bench and went to looking for the hacksaw, while Sammy continued to tap away at the piston head and to nod at his helper. He kept one eye on the owner, and when he saw that the little stock of patience possessed by that worthy was about exhausted he had the engine turned so that the head was as far back as it would go, and, to his relief, he found it was far enough to put the first ring groove out over the counterbore. He also found that this was the ring that was doing the sticking, and in a very short time the head was out.

The sticking was caused just as Sammy had surmised, as soon as he found it was not in the crosshead thread. The ring slots were ¾ of an inch wide, while the rings were ⅜ of an inch wide, and there were two of them in each slot. They were turned eccentric, being thinner in the middle than they were at the ends. A piece had broken from the end of one of them and had fallen behind the other one near the end.

The rings were not pinned in the head and the spring of them would naturally hold them out against the cylinder and help to keep them from turning. The grease would carry the broken piece up behind the ring, and before it would get to the thickest place it would jam and make a very effective lock. The tapping on the head either made the piece drop away or else it made the ring turn. Whichever way it worked, patience and a good helper got the rod out.

The cylinder was not hurt, and it was not much trouble to file up the rod where the tongs had cut it. The tongs' marks did not do any harm, although they did spoil the looks somewhat.

Instead of having to wait while a night job was being done, the owner only had to get a ring from the stock on hand, and was away from the shop before the regular closing time, and Sammy was happy because he did not have to do the sawing.

We have become so accustomed to the latter-day kind of hacksaw blades that it is likely that many men never had the pleasure of trying to saw hard machinery steel with a "Stubs" blade. Even after the new sort of blades were being made good, and so cheap that for most work they were cheaper than the others would be as a gift, there were people who would not use them. The idea that the new sort of blade had to be thrown away when dull seemed to many to be wrong, and that idea is not so uncommon as might be supposed. It took a lot of advertising and persistent pushing to bring even such a really good thing as it is to the front, and to teach people to throw it away when worn out.

W. OSBORNE.

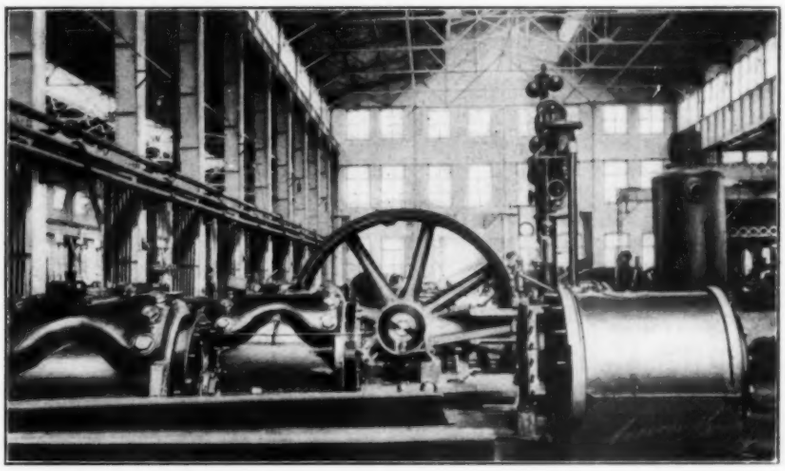


FIG. 36. MIDDLE OF ERECTING SHOP.

FIG. 35. DRIVE FOR BELT COMPRESSORS.

Foreign Markets for American Machinery.

Several very substantial orders have been received by British engineering firms from Argentina during the present year. There has been, for instance, an enormous increase in the amount of the rolling stock of the principal Argentine railroads, and English makers have received very satisfactory orders indeed, in this section alone. For example, orders for additional rolling stock for the Great Southern Railroad amount to 2,000 new 40-ton wagons and sixty-six new locomotives. These are now being shipped as rapidly as possible from Britain. The same company has given an order for 1,000 steel sleepers, while orders from other companies aggregate to some millions of pounds sterling in value. Some of the leading companies in the Republic have now fitted up and thoroughly equipped their own workshops for the manufacture of rolling stock and machinery, adopting what is best in the various British and American types, but adhering rigidly to neither. The bulk, if indeed not all, of the goods wagons are being supplied from abroad, and here again British makers have been well stocked with business. All the grain machinery fitted in the extensive grain elevator belonging to the Buenos Ayres & Rosario Railway Company, erected last year, was supplied from Lancashire; while the thousands of tons of iron girders on which the elevator is constructed were likewise supplied by British makers. This building contains fifty-six different motors and dynamos, and all were made and shipped from Manchester. English makers likewise sent the large weighing machines, the belting, the multiple endless wire ropes, the Crossley gas engines, the Dowson gas-making plant and the corrugated iron sheets used on the exterior of this building. The Rosario Drainage Works and the water-works of the same city have obtained their plant mainly from Britain. The Germans control the capital of the Rosario Electric Lighting Company, and consequently their makers of electrical machinery have obtained the business, except in engines and boilers,

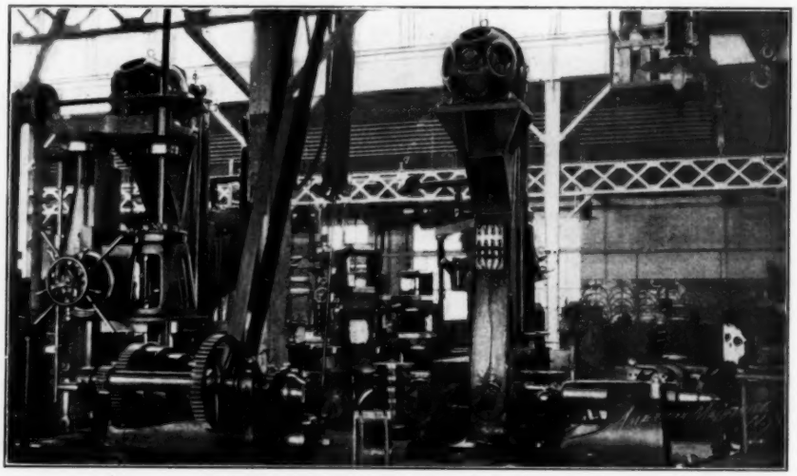


FIG. 39. BACK OF ELECTRICALLY DRIVEN RADIAL DRILLS.

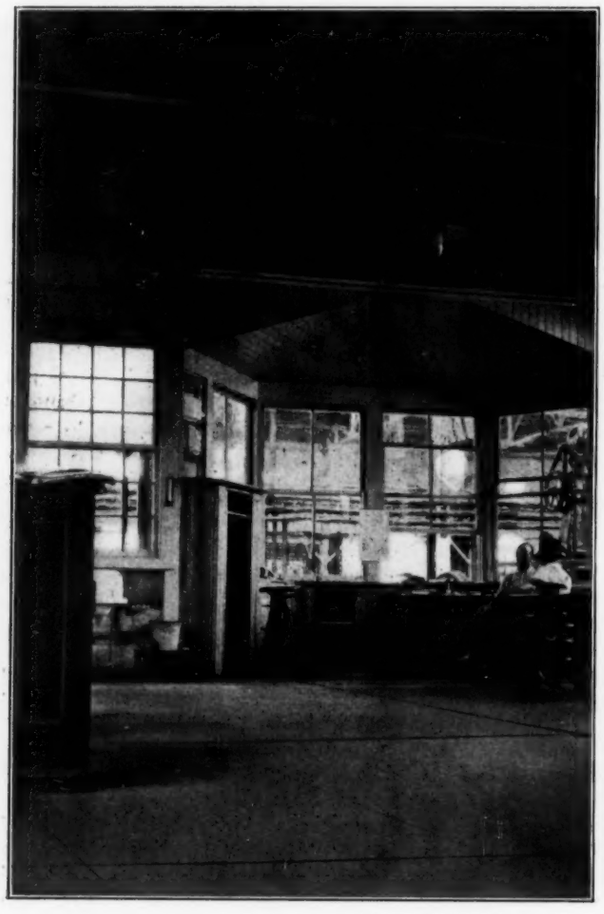


FIG. 37. COMPRESSOR SUPERINTENDENT'S OFFICE.

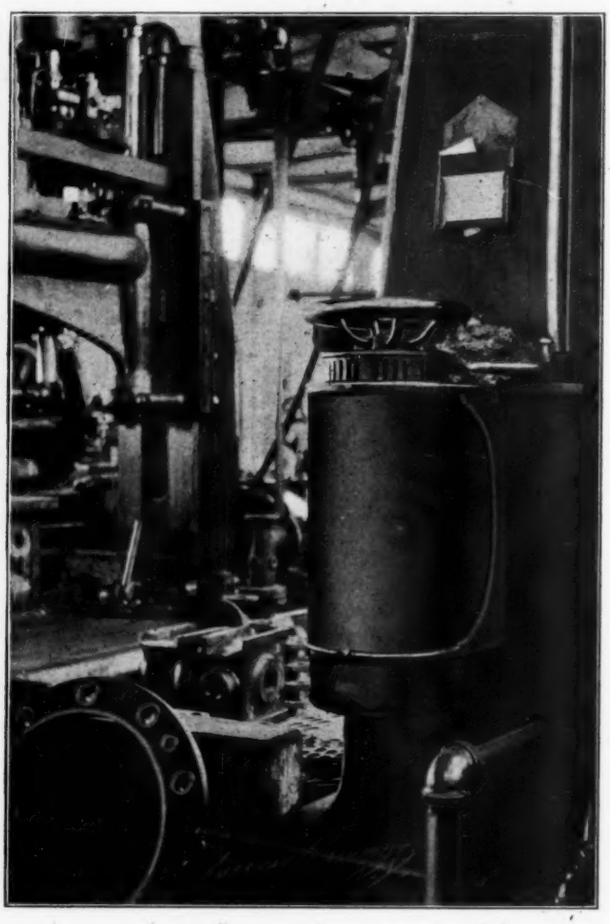


FIG. 38. CONTROLLER ON RADIAL DRILL.

both of which were supplied from British houses. The French makers of sugar-making plants are competing in South America generally very severely with British manufactures in this branch, especially in Brazil, where the Fives-Lille Company has the principal part of this trade.

In Buenos Ayres there is a steady demand for all machines connected with agriculture or grazing; general machinery, tools, fencing wire, iron posts, padlocks (in sets), windmills, pumps, iron pipes, elevators, stone-working machinery, etc.

Mexico is an excellent market for manufacturers of electrical plants. The principal source of power in the country is electricity. The local industry, which is rapidly developing, adopts this power more and more, ordering larger machinery from year to year. The principal cities in Mexico are lit by electricity, and the tram cars are also thus driven. At present a good deal of the electric material employed is of German origin. There is an excellent opening, however, for all manner of electric fittings as well as for dynamos, cables and everything required for tram and for telephone installations.

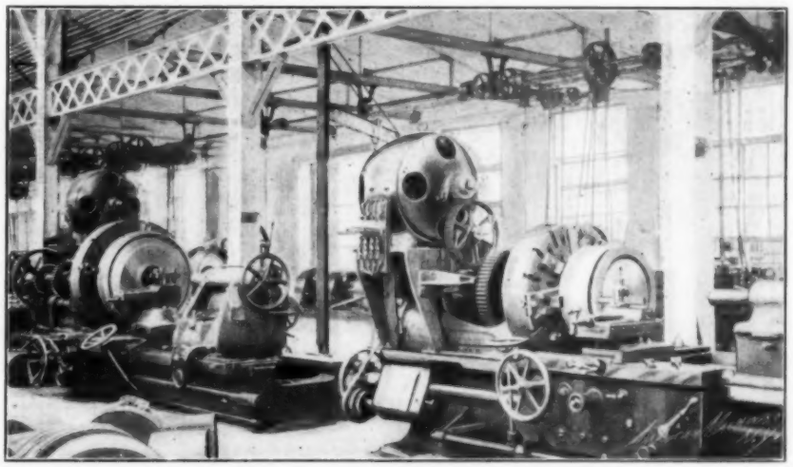


FIG. 41. LARGE LATHES WITH MOTORS ATTACHED.

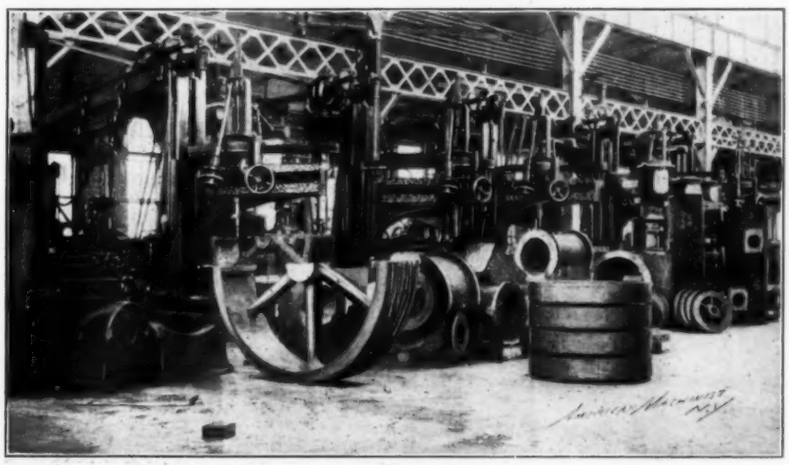


FIG. 40. FRONT OF ELECTRICALLY DRIVEN RADIAL DRILLS.

The British Trade Commissioner in Siberia, in a lengthy report on that market, says that the most satisfactory way to extend business there in machinery, tools, appliances and general miscellaneous articles would be for manufacturers to start combined stores, or representative agencies, in some of the chief town centers. These would act in the interest of several firms together, not competing one with the other, but sharing the expenses, and thus enlarging the exhibits. With stocks suitably selected, according to local requirements, more especially as regards tools of all descriptions and simpler mechanical contrivances, and with a variety of other goods, such as sanitary appliances, cycles, filters, cutlery, sewing and knitting machines, cheap arms, etc., a large business might gradually be developed. Fair credit terms to purchasers with local experience would soon facilitate transactions. Much, too, might be done by sending out goods to existing firms to be sold on commission. This course would at least put them on show and in stock, which is all-important. Siberian firms in the machinery line are not extensive or wealthy establishments, and cannot always afford to purchase outright; but many of these Siberian firms state that they could sell machinery and tools if they had been thus obtained and exhibited. It is essential that the market conditions should be thoroughly studied and local wants taken into account.

F. C. C.

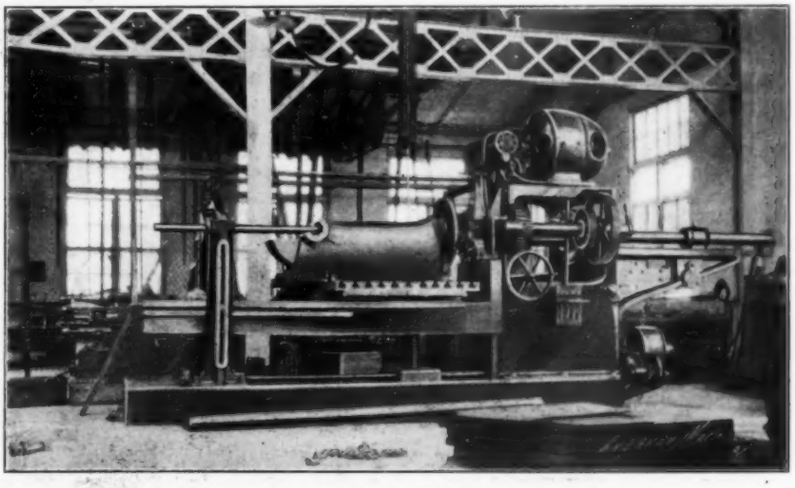


FIG. 42. LARGE HORIZONTAL BORING-MILL MOTOR.

On Saturday, July 29, the employees of the Remington Typewriter Works, at Ilion, N. Y., had their first annual outing and field day sports at a new baseball park just opened by the company, the attendance being about 1,500. The park is located on East River street and contains 15 acres; the grand stand and bleachers will seat about 700 persons. General Manager Calder made the tender of the park in an interesting address and Secretary Burke, of the Remington Typewriter League, responded. It seems that in this league there are seven departmental teams, showing that at Ilion, at least, there is little danger of the national game dying out for lack of interest.

A Reason for a Victorian Tariff.

Writing of the prospect that a tariff for protection may be enacted in Victoria, Australia, a correspondent of the New York *Times* says:

The policy of Mr. Deakin (the new Prime Minister) has been largely influenced by Victorian manufacturers who desire to place an embargo on all imported commodities which come into competition with their own productions. They are bitterly hostile to some of the American exporters, and one of the chief reasons for increasing the imposts on imported agricultural machinery of American origin is the alleged piracy by an American combine of an improved harvester, which is being imitated in the United States and sold in Australia at prices considerably lower than those at which it can be locally produced. And as with harvesters, so with many other commodities.

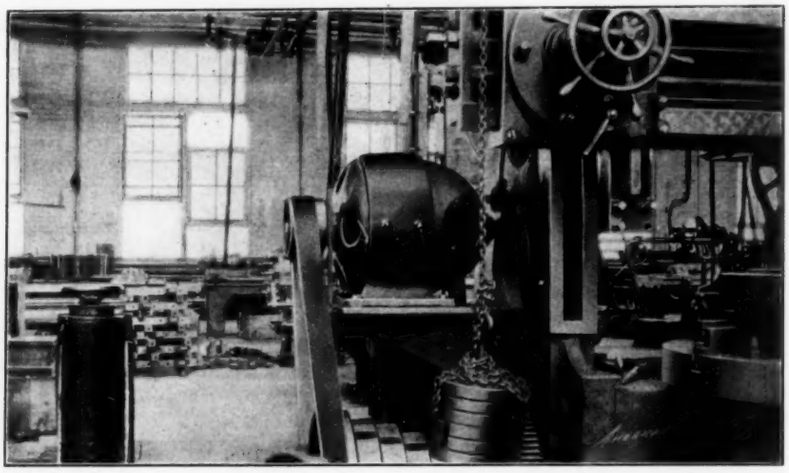


FIG. 43. MOTOR DRIVING OF VERTICAL BORING MILL.

The ferryboat "Richmond," one of the municipal fleet of five boats to be operated by New York City between the Battery and Staten Island, and the only one of the five constructed in a New York yard, had her trial trip recently and covered a measured mile on the Hudson River in a little over 3 minutes. Under forced draft she steamed over a course of several miles at the rate of 20 miles per hour, and during her builder's trial a few days previously attained a speed of 22 miles. The run from the Battery to St. George, a distance of something over 5 miles, was made in about 16 minutes with tide and wind against the boat; and the indications are that she will, with her sister craft, prove about as speedy as anything in the local passenger service now afloat in New York waters. The "Richmond" was built in the Burlee yards at Port Richmond, Staten Island, and along with the four others of the municipal fleet will enter the regular ferry service upon the completion of the larger and deeper slips now under construction at South Ferry and St. George.

In Jack London's latest book he says: "Had he been born fifty years later, Andrew Carnegie, the poor Scotch boy, might have risen to be president of his union, or of a federation of unions; but that he would never have become the builder of Homestead and the founder of libraries is as certain as it is certain that some other man would have developed the steel industry, had Andrew Carnegie never been born."

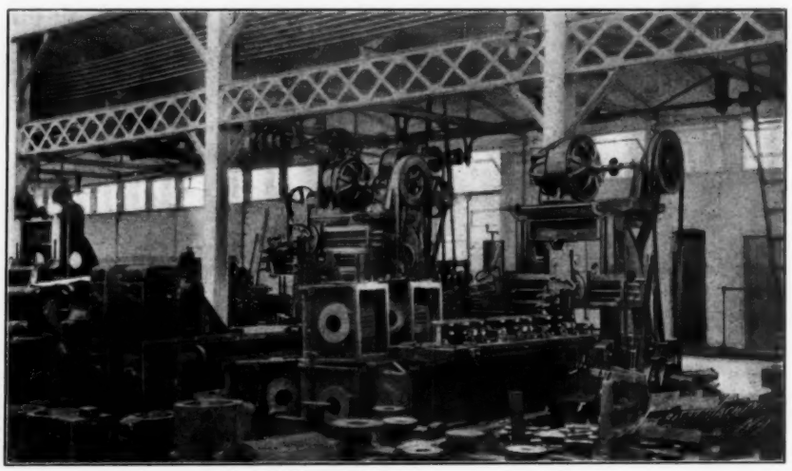


FIG. 44. ELECTRIC DRIVE OF PLANERS.

FIG. 45. COMPRESSOR CASTING YARD.

Notwithstanding the experience of the navy with anthracite coal in the past, the Navy Department will carry out some so-called experiments with this variety of fuel in the immediate future. It has been truly said by the older officers in the navy that the battle of Santiago could never have been fought with hard coal in the bunkers of the American fleet. The facility with which steam can be raised with bituminous coal when a sudden emergency arises can never be attained where anthracite coal is employed. Bulk for bulk, bituminous coal will carry a vessel further with less fatigue to the fireroom personnel than hard coal—*Army and Navy Journal.*

A peck of potatoes, in Gloucester, equals 14 pounds. A peck of potatoes, heaped, in Gloucester, equals 16 pounds.

Shop Tools and Methods.

BY F. J. LE CARD.

Fig. 1 shows a square block and a flat plate for getting the sides of small work at right angles, and constituting one of the most useful tools I have. It would be preferable, of course, to have both pieces of hardened and ground steel. In this case *a* is such, while *b* is made of mild steel. Both, however, are ground accurately, *a* being perfectly square on all sides. It is thinly coated with Prussian blue, for spotting the work to be scraped or filed square. The coating should be applied in any kind of work for spotting very thin, and free enough from oil not to flow. By holding the work to be squared firmly on *b* and rubbing it against the blueing on *a*, the point at which stock is to be removed is readily seen.

Fig. 2 represents the drill-holder made by the O. K. Tool Holder Company, and illustrated some months since in the AMERICAN MACHINIST. I have reproduced it here to bring out what struck me as some very nice details in its construction, and which also illustrate how we can go along for years under the impression that we have the best there is, when in fact we are quite a ways from it.

For example, I made and have used for years a drill-holder, like Fig. 3, for small drills—say, from No. 60, or smaller, to ¼ inch. I used a double holder, as I have seen others; and some use two holders instead; and of course a small, light handle is better for very small drills. In either case the point of screw *c* for small drills must be sharp to reach down into the V; and this makes the screw a poor one for holding the drills, especially the larger ones. So a screw with point like *d* is used for the larger sizes. The bottom of the V, too, as all know, must be parallel and free from any drill-point depression, or the drill used will be crooked.

In the O. K. tool, Fig. 2, the sink *f* allows the point of the holding screw *g* to catch the larger drills, and also come down close to the small, unbroken part of the V and hold the No. 60 drill, the broad end of the screw getting a long bearing on the drill. The sliding double center *h* adapts itself to the end of any size drill. The countersink *i* in conjunction with the screw *J*, cut half away on the end, limits the movement of *h*. The tightening pin *k*, used in the hole *l* for larger drills, is nicely housed in the handle and held by friction of the spring *m* snapped into the chamber in the end of the handle. It seems to me this tool is a sample of completion in design, both as regards utility and taste.

Fig. 4 shows a tool used in cutting out some circular saws. I had a hundred of these saws to make from 4-inch stock, about 0.040 inch thick. After laying out the work diagonally with the strip, to save metal, I drilled holes ¼ inch and cut the ⅝-inch arbor holes out with a one-tooth hollow mill like that in the sketch. Unless wishing to make a correct job by working with the centers and steady-rest, the hole for the cutter *n* may be gotten approximately right, after turning the shank *o* in a three-jawed chuck. Have the hole for some standard size drill rod—say in this case 3-16—and put in the set-screw *p*. Now catch the shank *o* in a three-jawed chuck and get the hole for the ¼-inch guide pin or tit *q*. Mark the work, if need be, to get it true in the chuck again. After getting the hole true and reaming for *q*, put both pins *n* and *q* in place and turn off *n* to as much under ⅝ inch as is needed for reaming—1-64 to 1-32. To do this, measure over the tit and the turning as seen by the dotted lines where they measure 7-16. The latter of course would give ⅝ inch for the cut unless turned under this size. Then back off to a small point, leaving the cutter as short as practical.

In Fig. 5 the dotted lines showing the cut-out stock explain how I got 100 tool-steel washer blanks, handy for various uses. I made a practice of keeping and marking waste tool-steel especially, and Fig. 6 shows how I have just found some of the same washers quite serviceable. I had a double half joint to make, one of the parts being like Fig. 6, and used four of these blanks for two pairs of filing buttons.

Most bench-lathe equipments include a ¼-inch screw or nut arbor, and the washers can be turned on this; or a brass plug like *r* is easily made to hold the buttons for filing to. If a routing file, like *s*, running in the lathe or drill press, is used, then a short plug of brass filling the work and the washers can be used, and slightly riveted at *t* if need be.

This gives a flat working surface to rest on the drill table or the drill plate in the lathe tailstock, while the file, running at a high speed, profiles the work to the buttons. The sinks for the joints, if many, can be made with a counterbore, or if only one or two, may be made quite readily with the bench-lathe slide-rest.

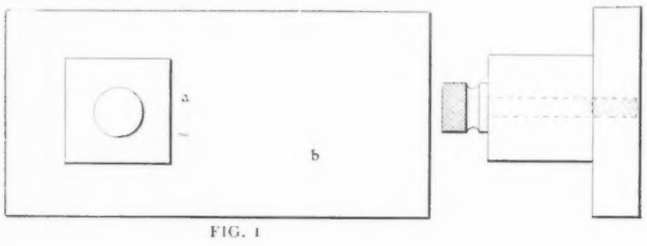


FIG. 1

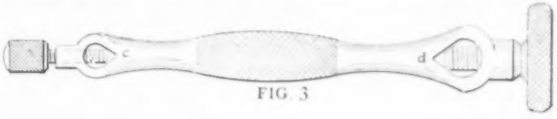


FIG. 3

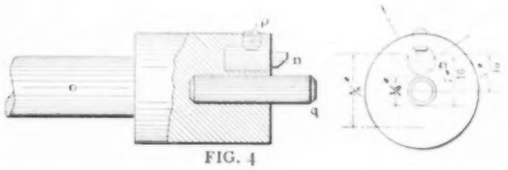


FIG. 4

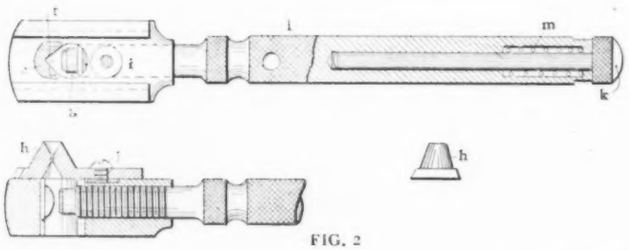


FIG. 2

FIG. 5

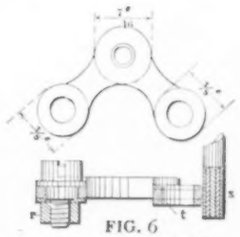


FIG. 6

American Machinist

SHOP TOOLS AND METHODS.

"If explosions occur in the muffler of the gasolene engine, add more battery," advises a contemporary. It may be a case of weak mixture, when the user will have to add more gasolene.—*The Gas Engine.*

At a meeting of the American Chemical Society, held at Buffalo in June, a paper was presented on Monobromalkylketodihydroquinazolines. It required two chemists to handle it however, and even then there were times when it was feared that parts of the title would get away.

A society of motor omnibus engineers is being formed in England.

Letters to the Editor.

A Boring-Bar Kink—Use of References in Getting a Job.

Some years ago, in an Eastern shop, I saw a little boring-bar kink, and it has since helped me out of many a hole, and as I do not remember reading any account of it heretofore, I will venture to describe it and its application as I first saw it.

In itself it is simply a boring bar with one end fitted to the hole in the hollow spindle of a lathe, while the other end is held in a clamp socket that bolts into the tool-post slot on the slide-rest. This clamp socket may be made in one size, or it may be made large with split bushings, but the spindle hole, supporting the other end stiffly, makes it a hustler on long holes where it can be used.

The only time I saw it used outside of my own shop was in boring and counterboring engine cylinders for about 5x8 or 5x10-inch engines in a lathe of about 18 inches swing. The cylinders were chucked and a large pipe center was run in the outer end, and, after truing up, the outside flange was turned off and a steady-rest was dropped into place. Then the end of the cylinder was faced off and the boring bar substituted for the tool-post and tool. The cylinder was finished with two roughing chips and one finishing chip, and one end was then counterbored. To hold the cylinder while turning and facing the other end, a special arbor was then used that allowed a tool to be inserted for counterboring on that end.

I have noticed letters from different writers regarding the sending of references in reply to ads. for men in different capacities and of the trouble often arising therefrom. So far I have always been fortunate enough to elude any trouble of this kind, but I have had one or two experiences with references that go to show the temperament of some of the men one meets, also some peculiar methods.

Some years ago, after a service of about six years in the South as master mechanic of a textile finishing plant, the ill health of one of my children made a move to a more temperate climate imperative; so, after a sixty-day notice to my employers, I left for New England, parting from my superintendent and manager on the most cordial terms and carrying in my pocket one of the most flattering testimonials I ever had, and more valuable to me because it came unsolicited.

After a month's rest, I decided I would try and get a job in some up-to-date tool shop, and thus absorb any new ideas about doing work that had developed during my stay in the South. As I had been a constant reader of the AMERICAN MACHINIST for many years, I did not feel that I should be very much out of date no matter where I got a position.

Selecting one of the most prominent of the tool-building concerns, I went to the office and applied for a job as a machinist; any job—I was not particular what branch they chose for me to work in. I was led through a number of offices, and finally was left in someone's private office for what seemed to me an interminable time. Eventually the someone arrived, and he was—as I afterward learned—the superintendent. He asked my name, age; was I married or single; how long had I been a machinist; where did I serve my apprenticeship; where was the last place I worked, and how long did I work there? Then he expressed the opinion that I was probably out of practice and would be of little value. Did I have any references from my last employers, or could I refer him to them? I gave my latest reference, and he read it with apparent care. Then he proceeded to comment on the fact that the typewriter did not distribute the ink evenly; that the stenographer who used it had misspelled a word, etc.; finally calling a clerk and sending me to the foreman of the erecting floor of one class of machines built there.

This gentleman proceeded to ask me about the same line of questions I had already answered, and then told another clerk to show me where my clothes-hook would be, get me numbered, etc., and I was instructed to appear the following morning for work. "But," I suggested, "what pay am I to get for my work here when I do come?" Oh, he would adjust that all right after I had worked there a week, so that he could gage my abilities. I told him it was to me a rather unusual thing to work a week before I found out what I was to receive; but as I could get no further satisfaction, I decided to give them a try anyway.

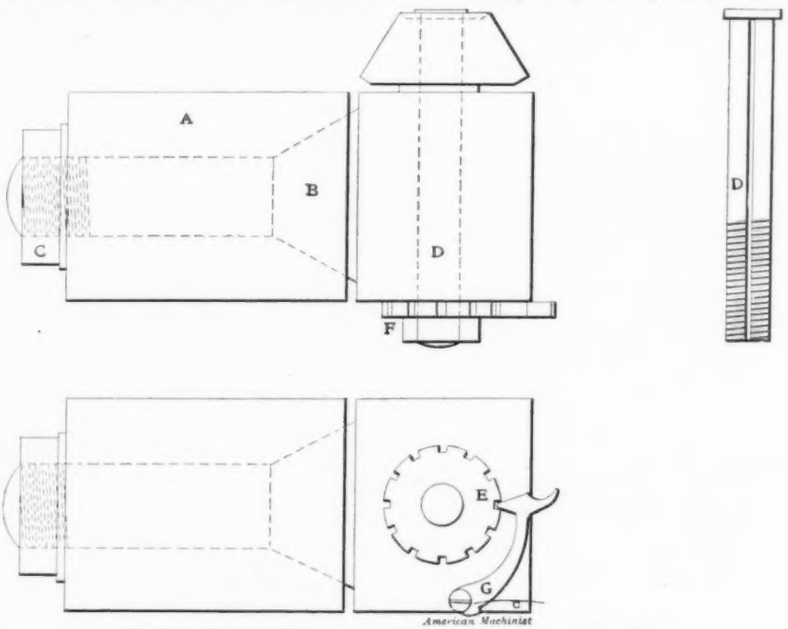
During the week that followed I was instructed by the "boys" that he (the foreman) would come to me on the day before pay-day and tell me that, as I was not accustomed to their methods, he could pay me only 22 cents per hour for a start; but after a few weeks (or months) he would advance me at least 2 cents per hour.

This information turned out to be correct, and the foreman's little "spiel" was an almost verbatim copy of the above. So on the day after pay-day I stopped out with the rest of the drunks and looked for another job. This time I looked for a little shop in the district where a certain line of fine machinery is made, and, fortunately, found one that was shy a gang foreman. Here, as the superintendent cared less for my antecedents and more for my ability to deliver the goods, I made a fresh start. L. L. ARNOLD.

Clear Water, S. C.

Cutting Bevel Gears on the Shaper.

The sketch shows an attachment to be used when planing bevel gears on a planer



FIXTURE FOR HOLDING BEVEL-GEAR BLANKS IN THE SHAPER.

or shaper. I have used this to good advantage, owing to the fact that we have no milling machine. Referring to the drawing *A* is a square block of machine steel with a hole bored through and with one of the ends chamfered. *B* is a steel bolt square at one end and turned with a conical neck to fit in *A*. *B* is held at the required angle by nut *C*, which bears against a washer. A hole is drilled through *B* at the square end and mandrel *D* which is splined up to the head is turned to fit it. *E* is the index dial which may be a lathe gear and *F* is the locknut, *G* being the index finger. The shaper vise must be swung each way from square position in order to give the teeth the required taper. I generally rough the job out with a straight tool and finish with

a forming tool. This will make three operations. The sketch shows a blank gear in position, on the attachment.

P. BRICKNER.

Grinding Cams.

We have a great many cams to make as shown in Fig. 1, which are of cold rolled steel, case-hardened. These cams are made in imitation of another manufacturer, and we have never, heretofore, been able to make them exact, our customers constantly complaining that our cams were not as good as the *genuine*. Seeing, then, that it was necessary to make them exact, we decided to grind them, and the rig, Fig. 2, was made to do the work on the grinder.

The drawing seems very clear; still, a word of explanation may not be unacceptable. *A* is the base, with the cam-stop *B* and the fulcrum lugs *C* cast on. *D* is the spindle carrier, which is mounted on rock shaft *E* and carries the spindle *F* at the top end. The spindle is held in position by the driving pulley *G* and the collar *H*. At *I* is the genuine cam (of which I shall have more to say later), and at *J* is the cam to be ground. *K* is the emery wheel. The lever *L*, which is secured by a headless screw to shaft *E* (to which shaft the lower end of the spindle carrier *D* is also fastened by a screw), is drawn forward by the spring *M* until the cam *I* comes in contact with the cam-stop *B*.

The cams are rough milled on the cam cutter, no particular care being taken as to their exactness, whereas heretofore every care was taken without avail; they are held in position by screws which fit in a spot on the cam cutter shaft. These screws it is necessary to have in the same position in each cam. The cams are then case-hardened and ready to be ground. On the shaft *F* are drilled two spots *N* and *O* in perfect alinement. The screw at *N* locates the model cam I, while that at *O* secures one of our own rough-milled cams to be ground.

As the pulley *G* rotates, the spindle-carrier *D* takes a rocking motion, as cam *I* is held against the stop *B* by the spring *M* and lever *L*. The cam *J* necessarily takes the same motion against the emery wheel *K*, and is ground to a perfect facsimile with a perfect surface.

Our customers are now telling us our cams are better than Blank's. You see, Blank's are not ground, and have the plain case-hardened surface, while ours are beautifully polished.

C. H. RAMSEY.

A Big Repair Afloat.

Two years ago a repair unusual in the method employed and the utilization of the ship's gear was carried out afloat in dock.

The steamer—one of a fleet of freighters employed in the China trade—was of the usual freight build, 1,800 tons register, 3,500 tons dead weight. The engines were of the ordinary inverted type, triple cylinders; high pressure, 23 inches; intermediate pressure, 47 inches; low pressure, 70 inches; and their total weight was between 80 and 90 tons. Two single-ended Scotch boilers, 15 feet 6 inches diameter, 11 feet long, weighing 20 tons each, were the equipment for steam raising.

Upon survey, the ballast bank under the engine and boiler room was condemned by the insurance surveyor and the owners advised to replace it. The superintendent of the line decided that the engines were not to be dismantled. Several methods of doing the job were discussed, but the following was carried through:

The principal appliances used were a large pair of three- and four-sheaved blocks, used with a luff tackle of three and four sheaves, giving great power; an iron block with a single sheave used on the foremast as a fair lead; a quantity of boiler tubes; a stout timber carriage to fit the radius of the boilers, substantially made, bolted together and provided with flanged wheels; rails for the carriage runway; and finally, a pair of 50-ton hydraulic jacks.

The ship's donkey boiler was shifted to the deck and connected to the deck steam service, to run the winches and dynamo. The whole of the pipes—main, auxiliary-steam, feed, exhaust and bilge—were disconnected, labelled and put down the after hold. This was no small matter. The whole of them were used again and brought up when wanted.

The bulkhead between the forward holds was strengthened by bars and chain blocks. The cross bunker between the boiler room and the hold was taken down in sections and marked for replacement; this gave a clear road into the forehold.

The beam between the engines and boilers consisted of a plate in two pieces and four angles riveted together; the stringers on the ship's side prevented this from being moved bodily, so the rivets were knocked out, the plates taken down and a furnace used to heat and bend the angles. These were afterwards replaced, a good job being made, considering the means used. Meanwhile, the engine holding down bolts were knocked through into the tank. The gratings were disconnected and the shaft coupling bolts taken out, so that all was clear for shifting.

The seats of the boilers were taken down, one boiler at a time, the carriage being placed under the boiler and on the runway. The tackle was rigged from the strengthened bulkhead, a cat's-paw made in the tail of the fall to hook the lower block of the luff tackle into, and the end of the luff tackle was taken up through the block on the foremast, then down into the winch barrel. Steam from the donkey boiler was used. The boilers were in this manner run as far forward as possible.

The engines having been lifted with the jacks, the fitting pieces were removed and the boiler tubes placed under the framing. The tackle was rigged again, this time to the forward end of the engines; these were run forward just under the main hatch. The complete shifting took two days. In the position they occupied the engines were accessible for a complete and thorough overhaul, which they received.

The tank was in a very bad condition, the whole of the floors, etc., except the top plates under the engine seating had to be renewed. The corrosion caused by the alternate wet and dry spells, in conjunction with the boiler heat, being the cause.

The tip forward given to the ship by the position of the engines enabled the tail shaft to be withdrawn and a new

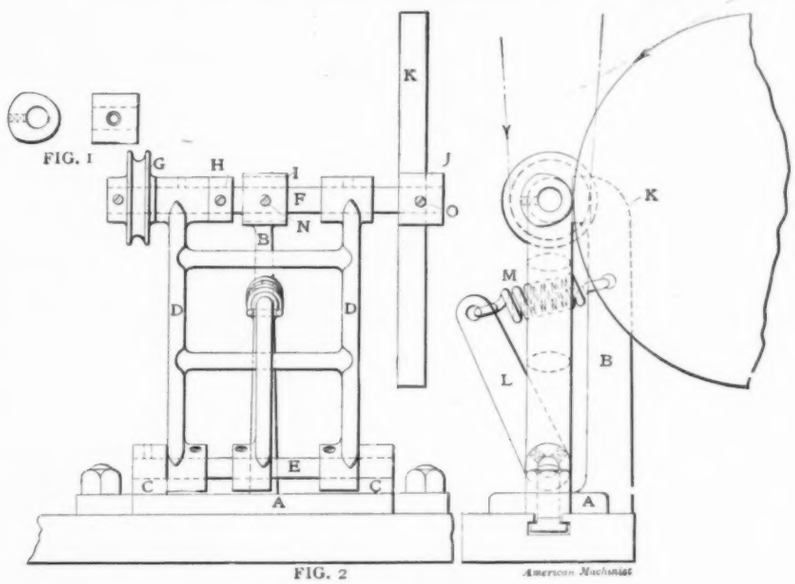


FIG. 2

CAM-GRINDING FIXTURE.

shaft and propeller to be fitted while still afloat. The replacement of the engines brought to light one peculiar fact: this was that the ship's floor had risen 1½ inches during the repair, in spite of being braced down with timbers. We ascertained this when the engines were chocked up to line with the shaft, the fitting pieces having all to be planed.

In lining up the shaft and engines, four pieces of stiff, thin paper were used to set the couplings fair; this is a usual method, and gives good results. The tank, when completed, was tested with 10 feet head of water—this by a pipe screwed into the tank top—and passed the survey satisfactorily.

That the repairs were well done there is no question. I sailed one trip before and one after the repairs, and our only stops on the subsequent trip were in answer to ring of the telegraph, which fact speaks for itself.

The total time taken was about thirteen weeks. A. L. Haas.

London, England.

Pneumatic Feed for a Multiple Drill.

The description of an air-driven shaper at page 85, Vol. XXVIII, Part II, has been of great interest to me.

An attempt is being made to use air as a feed to a multiple spindle-boring machine. A piston is secured to the end of each spindle and thus a direct, individual feed is secured. This will mean a considerable saving of feed mechanism.

Draftsman.

[By a strange coincidence an article describing a "pneumatic feed for countersinking ship plates" was printed at the same page, *i.e.*, 85, of Part I, Vol. XXVIII.—Ed.]

Peculiar Effect of Sea Water on Gray Iron.

I see at page 62, Vol. 28, Part II, that "Dixie" is calling attention to the effects of sea water on gray iron.

I have noticed that this action is much more pronounced when the iron is near or in contact with brass fittings.

I showed some of this graphite (?) to a doctor and, while he made no analysis, gave it as his opinion that the substance was chloride of iron.

I had a serious deterioration of this kind taking place in a large jet condensing pump where salt water was used, and it had become a question of a new water end before the season was out if means were not found by which this action could be stopped. I thought that the presence of brass indicated an electric couple and concluded to try zinc in metallic contact with the iron.

I think the same water end is still in use, although the zinc was first tried about four years ago.

The casting would probably weigh 2,500 pounds, and there was as much as 20 pounds of zinc consumed each month the condenser was in use.

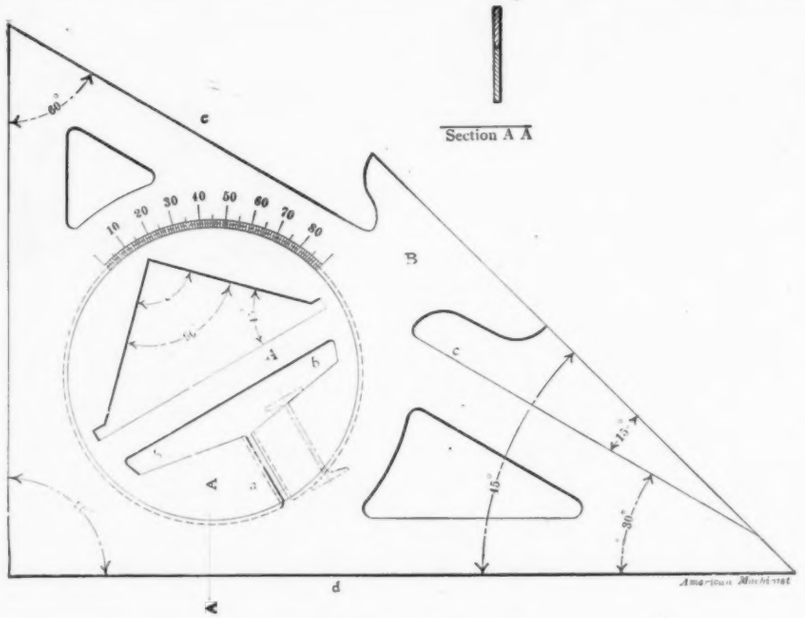
D. A. Manson.

A Combination Triangle.

I send you a sketch of a celluloid triangle that I made a few months ago, and have found a most useful instrument, as it does the work of a protractor and the 45-degree and 30-degree triangle without any inconvenience whatever.

Piece *A* is easily sprung into piece *B*, and is held in place by a V-groove, as shown in section *A A*. A taper key at *a* regulates the friction in the V-groove. Sides *b* of piece *A* slope 2:12, and can be used for sketching I-beams and channels.

When a long 30-degree line is required, side *c* can be held on the T-square, and side *d* will be the 30-degree line. Sides *e* are at 45 degrees to the center bar, and



A COMBINATION TRIANGLE.

are very useful when working on odd angles, such as offset bolt heads and dimension lines. The protractor is quickly and accurately set. *B* is graduated for only 90 degrees, but there will always be one of the four marks on the circumference of *A* without this quadrant of graduations. Homer E. Comtois.

British Pipe Threads—Straight and Taper Fittings.

W. H. Booth in his article on "British Pipe Threads," at page 112, Part II, says, "The common socket joint, with tapered thread and parallel-threaded socket, really makes a tight joint only at the extreme end of the socket, when the pipe has been screwed in until it fits at that one point only."

I do not know the practice of pipe manufacturers in England, but think that in this country all, or nearly all, the pipe fittings which are tapped out straight are made of malleable iron, and that all gray iron fittings are tapped with the same taper as the threaded end of the pipe, the taper threaded pipe joint being the style almost universally used in this country.

It is the claim of manufacturers that the malleable fitting being somewhat ductile, will stretch out at the end as the tapered pipe is screwed in and thus fit itself to the taper of the pipe for three or four threads in length, therefore making it possible to get as good or even a better joint than when using a gray iron fitting, if possibly the taper was not exactly correct, as the gray iron will not change its shape without cracking.

O. S. Bickford.

A Machinist Who Helped Himself.

Some time ago one of your correspondents urged that more of your readers take to writing "Letters to the Editor." I thought I might some time; then, editorially, you said, "Send in whatever suggests itself," with the assurance that you would treat it charitably. Though not a "spring chicken" in years, still in the mechanical line I am quite young, and perhaps my experiences may interest and help others who are just as new at the business.

I started to shift for myself at an early age and fell into the dry goods business, following it until I was twenty-five and a floorwalker. The job was always distasteful, and when a friend of mine, who, by the way, had worked up from an apprenticeship to a superintendency in a large shipbuilding concern, mentioned that he was looking for a draftsman for a mining company, I half jokingly said, "Why look further? I can draw," basing my presumption on a keenness at window-card writing. He said I might do,

and sent me around to interview the parties. After a little oral examination I was told that they would send for me if they wanted me, a way, I have since learned, that many firms have of dealing with applicants who hardly fill the bill.

When I went home that evening I chanced to see a copy of the AMERICAN MACHINIST in a news store. I had seen it many times before, but it had a new interest for me now, and I bought a copy. From it I copied a drawing and sent it to the mining company, together with some sign-cards I had written. They made an impression where I had failed, for I received a letter asking me to report for work the following Monday, at a salary equal to what I had been getting. This left me three days in which to become a draftsman. I hastened to my friend for instruction. He took a great interest in me, and assisted me in buying an outfit of instruments and a book about drafting. He taught me how to manipulate the instruments and to hold them like an experienced artisan and not as if they were crowbars; also how to sharpen pencils in the most workmanlike manner. He invited me to his home, and turned me loose among volumes of AMERICAN MACHINISTS and other technical journals, with instructions to never mind reading just then, but to study the drawings.

The work I had to do was not hard, and consisted mainly of keeping up the catalogue library, looking after the maps of property and mine and smelter drawings in the general manager's office, and to make sketches for him when required. I made it a point to familiarize myself with everything in my charge, so that at an instant's notice I could have at finger's tip and tongue's end whatever was asked for. I studied minutely the blueprints of the mine and smelter equipment, fixing in my mind all the general dimensions and capacities, and got acquainted with the technical terms. I read catalogues much as one would text-books, and looked them over and over until I was conversant with their contents. I studied the cuts in the advertisements that appeared in the technical journals, and practiced observation wherever I went of how things were built and put together. I avoided making a task of these things, but bore them in mind until I had formed a habit and did it unconsciously. It was this habit that made it possible for me to "make good" in a more responsible position as draftsman at the works a few months later.

Lack of shop experience handicapped me greatly, and I was too old to serve an apprenticeship and too poor to accept apprentice's wages. I found that on certain liberal conditions one could enter some colleges as a special student, that the tuition was limited to fees only, and that they had excellent engineering courses and shop equipment. I resigned my position and was permitted to enter and secured shop experience enough to enable me, when misfortune compelled me to discontinue there, to take a position in the repair shop of another large smelting concern.

My first month's experience was very trying, for my appearance, fresh from college, was anything but reassuring to the men about me, especially since the company had won in an ill-advised strike and the men in the shop were the only union men left in camp. I was looked upon by them with suspicion as a spy and treated accordingly. However, I minded my own business in spite of the annoying tricks, and was all eyes and ears for everything going on in the shop in the mechanical line. I watched with interest all the kinks of chucking and turning out work in the quickest manner. It was then I learned the value of the AMERICAN MACHINIST when bound as a book of reference, and especially the value of the experiences related in these columns, which enabled me to perform a few stunts myself.

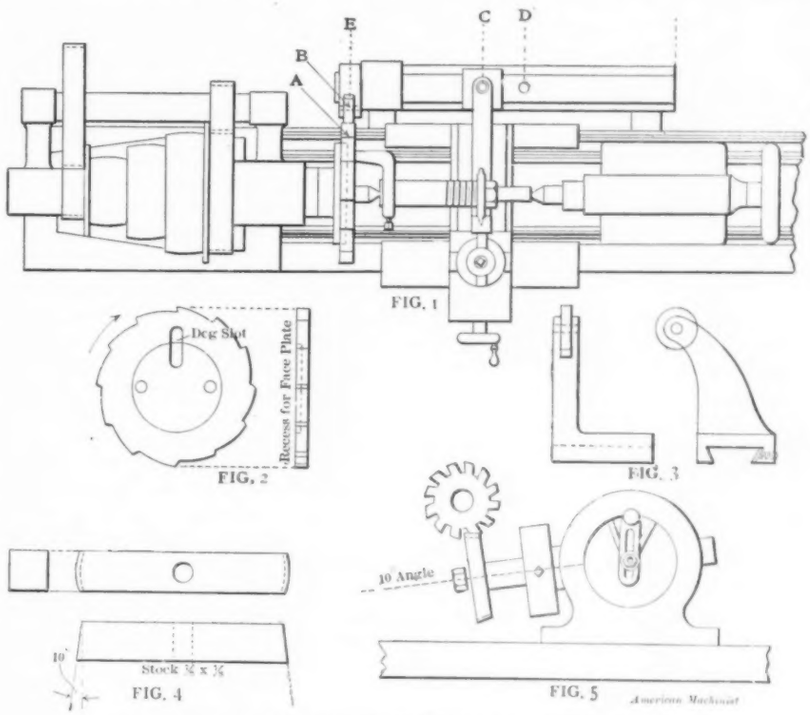
It was not long before I won the friendship of my associates and of the foreman, who often had me lay out his work and make sketches for the men to work to. After that my promotions came fast, and the chips of the shop have now a velvety hue.

My brief experience at college has been very profitable to me in the theoretical knowledge gained and in the impetus given to one's ambition to continue gaining knowledge after he leaves, in the meeting with the professors whose personalities are inspirations to forge ahead and accomplish something worth while.

My experience in the shops has been profitable in knowledge gained and impetus given to learn more from the workman who "does something" and answers your "blamed fool questions" cheerfully. My experience with the AMERICAN MACHINIST and its excellent drawings when a struggling draftsman, its excellent hints to me when a struggling machinist, and its excellent articles on machine design, etc., have made me your earnest and constant reader. SMITH.

A Relieving Attachment and the Making of a Gang Gear Cutter.

Having a large quantity of gears to manufacture of two sizes (viz., 12 pitch, 5-inch pitch diameter, and 12 pitch, 2-inch pitch diameter), I came to the conclusion that the only way to cut them was with a gang cutter. I had no relieving attachment with our Hendey-Norton lathe, so I improvised the attachment which I herewith describe. I found it to be very satisfactory, and, as far as I know, the only one of its kind.



A RELIEVING ATTACHMENT—MAKING A GANG GEAR CUTTER.

Fig. 1 shows the attachment set up on a single cutter. Fig. 2 shows the cam plate, and Fig. 3 the cam roll, these two parts being shown in position at *A* and *B*, Fig. 1. This attachment is applicable to any lathe that has a taper attachment drawing directly on the cross-slide and having a compound rest in conjunction. The principle is that you use the taper attachment guide to draw your former in. This guide is actuated by the cam roll running against the cam plate, which is fastened to the face-plate of the lathe. The cam is held in contact with the cam plate by a good stiff spring (not shown)

fastened to the cross-slide on the front of the lathe.

Our lathe was a 12-inch swing, so I made the cam plate about 10 inches diameter by 5/8 inch thick. The cams were laid out on the pattern with about the right shape so to give the proper relief when reduced and a movement of about 5-16 inch. All the work that had to be done on this casting was to recess it at the back, bore the bolt holes and grind up the cam faces slightly. The cam roll holder pattern was made as in Fig. 3. The piece was planed out at the bottom to fit the taper attachment guide and the cam roll fitted in, and we were ready for business. I think the whole time on the attachment was less than eight hours.

One beauty of this attachment is that you can get any desired amount of clearance. Most taper attachments are 24 inches long. As I stated, the cam plate had a throw of 5-16 inch, and you can get any desired clearance from zero to nearly 5-16 inch by moving your carriage *C* from point *D*, Fig. 1, toward point *E*. Of course you will have to move the work accordingly, and you can do so by having a series of collars on your cutter arbor.

I made one gang cutter 12 pitch with 4 teeth, and the formed tool worked beautifully, although it was taking a cut equal to over 1 inch in width.

In making a solid gang gear cutter, the radius of the teeth of course must conform exactly to the radius of the blank. As stated, our gear blanks were respectively 5-inch and 2-inch pitch diameter, 12 pitch, and I found that on the 2-inch blank I could cut 2 teeth and on the 5-inch blank 4 teeth at once.

I took 7/8x7/8-inch steel to make my formers of, planed two sides, bored a 1/2-inch hole in the center, then put them on an arbor and turned them up with a 10-degree taper to 5 2-12 and 2 2-12 inches respectively at the large diameter, as per Fig. 4. I then put them in the milling machine with the index dropped 10 degrees, as in Fig. 5, and cut each end as a gear blank; of course one end would do, but I had two chances for a good former after hardening, instead of one. After cutting, the former was hardened and tempered, and was then ready for business. The 10-degree angle gives a fine working clearance on all sides of the tooth. Of course a former made in this way will not stand grinding, for if ground the tooth would get smaller each time, and consequently make the gear tooth larger.

F. C. MASON.

Turret-Lathe Tools.

We have in our shop some old-style turret lathes which were in their day no doubt good machines, but in these days of heavy cuts and high-speed steel are behind the times. As they were badly crowded, I built the turret tools shown in the accompanying sketches. You will note that they are built with an overhang; not very good practice, but it was necessary in order to cut close up to the chuck. The carriage will not clear the chuck; consequently, the tool has to travel over the carriage. With an apprentice running this machine, we turn with the tool in Fig. 1 about 250 5/8x6-inch bolts per day of nine hours. We use a well-known brand of high-speed steel, and have turned 700 bolts without grinding, using compound for lubricant. Considering that the machine has a two-jaw independent chuck, I think it does remarkably well, as considerable time is lost in chucking.

In turning countersunk- and round-head bolts and screws, we use the first tool to turn the stock to the size of the head, and the second one ground to the angle of the countersink for sizing the body; this leaves the bolt ready for threading and cutting off. For cutting off the tool was made as per Fig. 2. This is from the same pattern as Fig. 1, with some minor changes. The tool *A* is carried in the sliding block *B*, which is of tool steel and hardened, and has a rack cut in the side, which meshes in a pinion at *C*, the pinion being milled in the solid shaft *D*. The handle has a hexagon opening where it fits on *D;* this allows it always to be placed in a convenient position. We use this tool principally for cutting off rough iron for studs. On this work we use a gage (not shown in the sketch), which does away with measuring. By using this tool we can run the turret back the full length of its travel and save chucking each time. As a test, I cut off fifty 3/4x3-inch studs in ten minutes. Of course we do not average this for regular work. We grind the tool so that after cutting off it will round off the end of the bar, ready for the next stud. I find that this tool, operated by a lever, is much more convenient than those using a screw.

At first I had some doubts as to the wearing qualities of the block *B*, which, as you will note, is not gibbed for taking up the wear; but after seven months of service (and apprentice at that) it shows no signs of wear. I am strongly in favor of Professor Sweet's idea of even-bearing surfaces, and follow that construction wherever possible.

W. T. H.

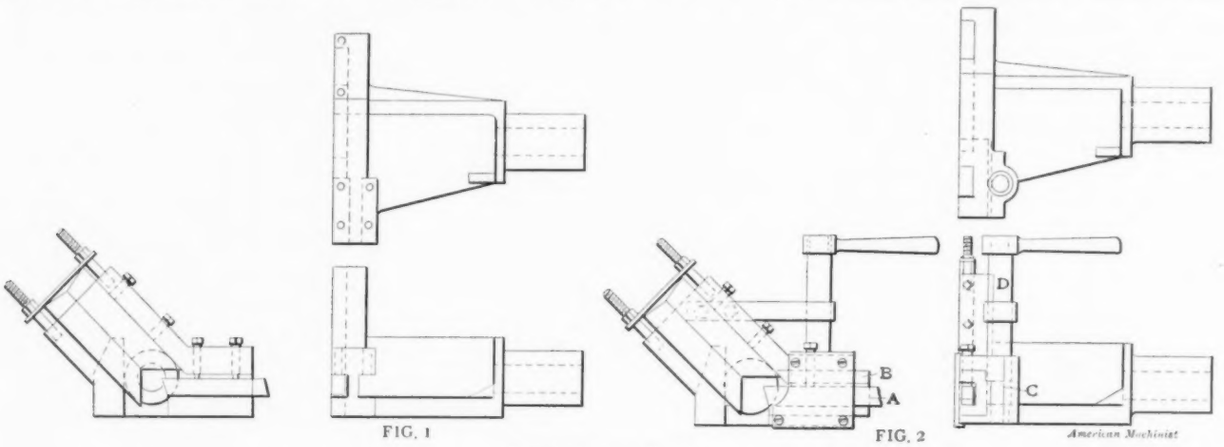


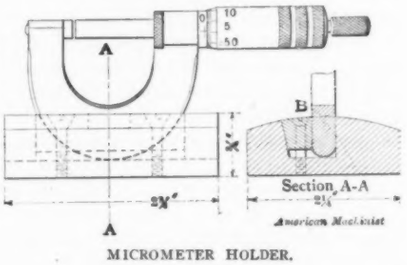
FIG. 1 FIG. 2

TURRET-LATHE TOOLS.

A Micrometer Holder.

When I first saw this holder I thought it was a pretty clumsy affair, and wanted nothing to do with it; so don't condemn it until you have given it a thorough trial, for I got used to the feel of the block in a very short time and now have a block for my 1- and 2-inch micrometers, and can make a piece measure the same every time I try it.

The holder is shown with a 1-inch micrometer in place, and the cross section *A A* shows the binder *B*. The block and binder are of wood, and the sizes given fit my hand. It is used in the hand or on the bench. When adjusting the binder,



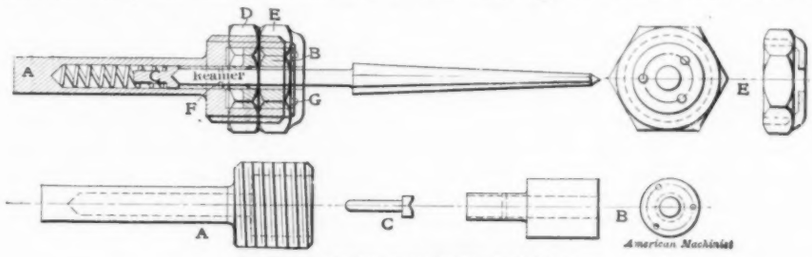
MICROMETER HOLDER.

be sure and not screw down tight enough to distort the micrometer; just enough to hold the block is sufficient.

This is treason! The block keeps me from carrying the micrometer in my pocket all the time, and on that account I have not been troubled with dust and grit getting into the screw. I have cleaned the screw once in four years, although during all that time it has been standing on a grinder or within a few feet of one. It is so handy to lay down and pick up, you don't think of putting it in your pocket. SCOTTY.

Friction Chuck for Taper Reaming.

We have very much taper reaming to do. We used to do it by hand, but it was too slow, and using a brace was a tedious job. We then tried the drill press, and that went all right until the reamer stuck and broke. Since then we made an arrangement like that shown in the sketch. We have no trouble now. *A* is the shank fitting the drill chuck; it is bored as shown. The small end of *C* fits the inside of the spring, which is put in the hole in *A*. The reamer rests on the other end of *C*. *B* is made an easy fit in the shank. On its face are three spots, where the balls *G* are seated. *B* is hardened. *E* is a nut; on the inside face it also has three spots for the balls; they are a little deeper than those in *B*. The hole in *B* is large enough to give the reamer some play. The pin *F* fastens the reamer and *B* together. *D* is a jam nut. Now, if it happens that the reamer sticks, the spring will allow the piece *B* to slip. The tension on the friction can be increased or decreased by adjusting the nut *E*. C. B.



FRICTION CHUCK FOR TAPER REAMING.

A Cooling Water Arrangement for Gas Engines.

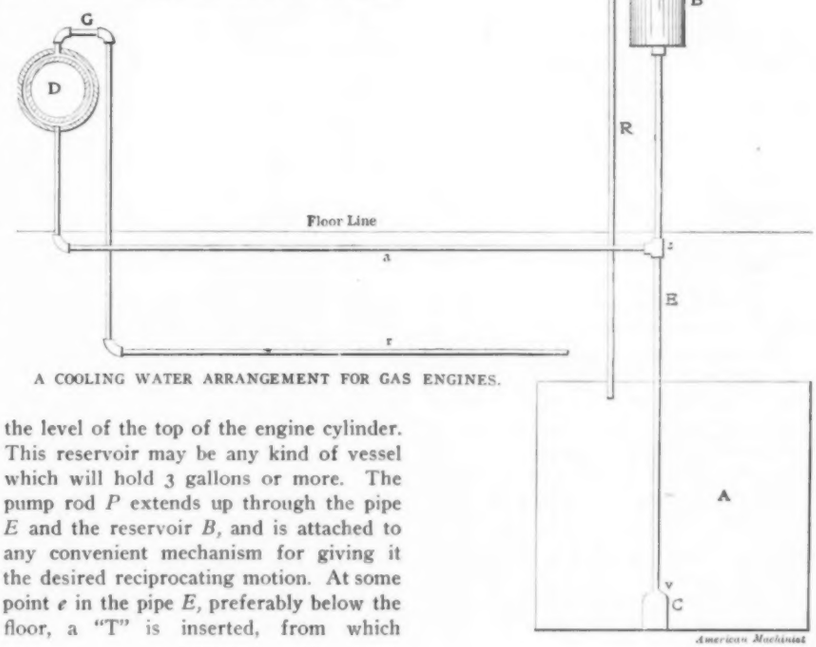
Gasolene engines have become an everyday matter; indeed, they and their next of kin, the producer-gas engine, bid fair soon to be "the whole thing" in the way of power generation.

It is reprehensibly common, when one sees one of these engines installed where the climate is cold, to find the water-jacket of the cylinder cracked, from having been allowed to stand full of water during freezing weather. Although this accident does not necessarily seriously impair the usefulness of the engine and, in mild cases, is easily repaired, it is a disagreeable and unsightly thing, whether repaired or not, and a word as to how to avoid it may not come amiss.

It is true that this freezing of the cooling water may be avoided by putting some glycerine in it (quite a large percentage, by the way), or by using oil to cool with; but, aside from the expense of either of these methods, pure water is decidedly the best cooling agent known, and the simple arrangement which I will undertake to make plain eliminates all bother and expense and saves some room.

First, make an underground cistern—a common wooden tank is all right and will last for many years—of sufficient capacity so that, supplied from the roof, it will hold enough to last all winter; thus securing a permanent supply of soft water and avoiding all trouble from lime incrustation in the cylinder. This will not require a prohibitively large tank, as there will be no loss, except by evaporation, and twenty-five or thirty barrels will ordinarily last a 10 horse-power engine for six months or more.

The tank is preferably placed so that the pump may be directly over it and arranged substantially as in the diagram, though of course each location will call for minor modifications in the arrangement. A common deep-well pump cylinder *C* is placed at the bottom of the tank *A*, and a pipe is carried up into the bottom of reservoir *B*, placed about 2 feet above the level of the top of the engine cylinder. This reservoir may be any kind of vessel which will hold 3 gallons or more. The pump rod *P* extends up through the pipe *E* and the reservoir *B*, and is attached to any convenient mechanism for giving it the desired reciprocating motion. At some point *e* in the pipe *E*, preferably below the floor, a "T" is inserted, from which branches the pipe *a*, entering the bottom of the cylinder water-jacket. The overflow taken from the top of the cylinder is carried back to the tank in any convenient manner, as by the pipe *r*. A hole, about 1-16 inch in diameter, is drilled at the point *v* in the pipe *E*, and left open at all times, so that, immediately the pump stops, the water drains back.



A COOLING WATER ARRANGEMENT FOR GAS ENGINES.

As it is difficult to gage the capacity of the pump so as to give the best results, and as such capacity will vary somewhat in any case, it is well to have it of ample capacity and to have a stop-cock at *G*, by which the flow can be gaged to suit, while the surplus is returned to the tank by the overflow pipe *R*, which is attached to the reservoir *B*, near its top. It might be well to remark here that about the highest degree of heat permissible in running gas or gasolene engines is generally conceded to be indicated by a cooling water temperature of about 150 degrees as it leaves the cylinder, which is about as high as the hand will bear without being scalded. The reservoir *B* is not absolutely essential; but without it one would have to carry the pipe *E* some distance above the overflow *R*, in order to avoid disagreeable splashing, and the pressure, and consequently the flow, would be somewhat irregular.

I have operated an engine, piped in this manner, for five years, in a climate which is "the limit" for low temperatures, without the slightest attention or expense, except to see that the pump was running. If memory serves, the entire amount of care involved has been the lacing of one 2-inch belt one time; and oiling, of course.

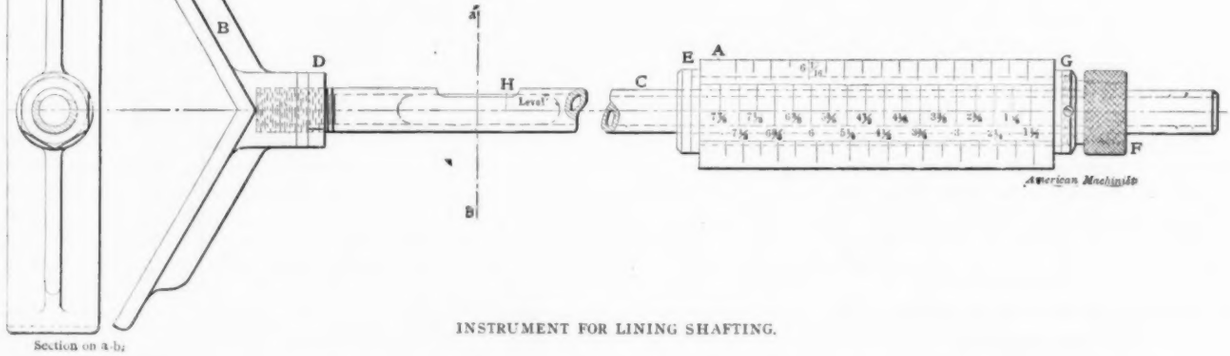
W. D. GRAVES.

Instrument for Lining Shafting.

This instrument is built on the principle, as proved by mathematics, that the ratio between the distance from the point of tangency of the head and the center of the shaft, and the distance from the vertex of this angle and the center of the shaft is constant; that is, if the distance between the center of the shaft and the point of tangency of the head with the shaft is increased or decreased a certain amount, the distance between the center of the shaft and the vertex of the angle increases or decreases in the same proportion. This fact has been made use of in graduating the sleeve *A*.

The head *B*, the angle of which is 120 degrees, or 60 degrees each side of the horizontal, could be of cast steel, of construction similar to the "center head" of the combination squares, in common use among mechanics. The rod *C*, of brass tubing of dimensions to secure stiffness, is nickel-plated, and threaded at one end to screw into the head, where it is held firmly in place by means of the jam nut *D*. This rod is of a length to suit conditions.

All other parts may be of tool steel. The sliding sleeve *E* has a shoulder at one end and a split taper thread at the other, by which it is clamped to the rod in any desired location by means of the nurled nut *F*. Just back of the taper thread there is on the sleeve a thread of a larger diameter to receive the adjusting collar *G*, which is used to take up any end play of the rotating sleeve *A*.



Section on a-b.

INSTRUMENT FOR LINING SHAFTING.

The threaded collar is held in position by a small headless screw.

The rotating sleeve *A* has six sides and 104 graduations, corresponding to all sizes of shafting from 1 7-16 to 8 inches, varying by sixteenths. The number of graduations may be reduced so as to include the sizes of shafts most commonly used, in consequence of which the number of sides may also be reduced.

Before proceeding to line the shafting it will be presumed that it has been leveled. To line horizontal shafting secure a line at one end and as near the center of the shafting as convenient. This line must be placed high enough above the center of the shaft so that it just clears the graduated sleeve when the shaft liner is held level as determined by the level at *H*. At the other end of the shafting, at the same distance above and from the center of the shafting, go through the same procedure, being careful to draw the line very tight to insure its being level, making it unnecessary to further inspect the level *H* in the lining operation.

Now, to adjust the graduated sleeve along the rod, take note of the size of the shaft at either end of the line and place the head *B* against the shafting; bring the graduation of the sleeve *A* corresponding to the size of the shaft directly under the line, and clamp by means of the nurled nut. Now proceed along the shafting, and at convenient intervals determine the size of shaft and then find the size on the graduated sleeve; unless the graduation comes directly under the line, the shafting is out at this point and must be brought into line.

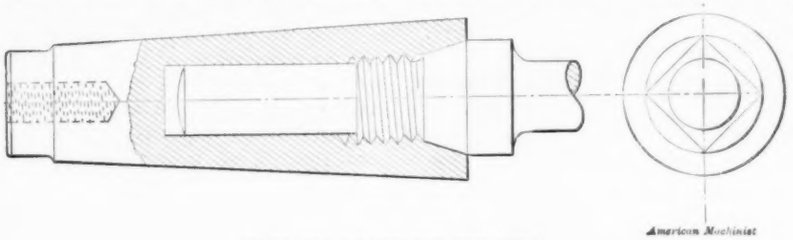
As an aid in finding the size desired on the graduated sleeve, it will be noticed that the graduations on any face increase 3/8 or 6-16 inch toward the head. Then, as there are six sides, the graduations increase by sixteenths when the sleeve is rotated toward the observer. If a 6-inch shaft were being noted and a 6 7-16 were wanted, note the number of sixteenths difference and divide by 6; the remainder being one, it is equivalent to turning the sleeve 1 1-6 times—or, to save time, 1-6 of a turn, the required graduation being found on the next face when the sleeve is rotated toward the observer.

To line vertical shafting loosen nut *D* next to the head and revolve the head one-quarter of a turn, so that it is horizontal when the level is observed from above the rod; tighten the jam nut and proceed as with horizontal shafting, after the required lines have been placed in position.

FRANKLIN H. SMITH.

Threaded Shank for End Mills.

Every mechanic has his troubles more or less; sometimes it is his own fault; other times the tools he may use. The threaded shank for end mills here shown is guaranteed to put a stop to all such troubles as gouged or spoiled work, where taper-shank mills do quite often work loose in the collet, or the spindle of the machine, causing damage when recessing, dovetailing, underscoring, or even when using a plain end mill.



THREADED SHANK FOR END MILL.

This mill is inserted in the machine by merely screwing into the collet or spindle by hand, then tightened slightly with a wrench. Then to remove, loosen with a wrench and unscrew by hand. It never locks or jams and is very easily put in or taken out; only a small space is required between mill and work to remove it, and no hammer or drift is needed.

Right-hand mills have right-hand thread; left-hand have left-hand thread. The collets have crossed right-and-left thread, thereby taking either right- or left-hand mill in the same collet.

The shank is proportioned in general dimensions, so as to compare with B. & S. taper shanks of the same numbers.

Any mechanic once using a mill with this shank will not care to bother with the taper shank again. This form has been used to a considerable extent for some time by one of the largest shops in the country, for dovetailing, T-slot and special end-mill work, and they are now considering its adoption for more general use.

U. B. SHURE.

Uniformity of Lettering on Drawings.

Having noticed several articles in the AMERICAN MACHINIST relating to the lack of uniformity in lettering on drawings, I would like to offer this article to the readers of this paper to show how we overcome this in our drafting room, with the idea that it will help those that are having the same trouble.

To do nice lettering takes a great deal of time. One must first get his distances between lines and then draw his light horizontal lines and do the lettering, and when through the lines must be erased. This, of course, takes up much of the draftsman's time, and should he lay out his lines by measuring them with his eye only, he loses the uniformity of his letters, for there are few draftsmen who can do this and maintain uniform spacing of the lines. If the reader doubts this, let him take one of the sheets he printed last week that way and compare it with the one he printed to-day, and see the difference in the size of his letters.

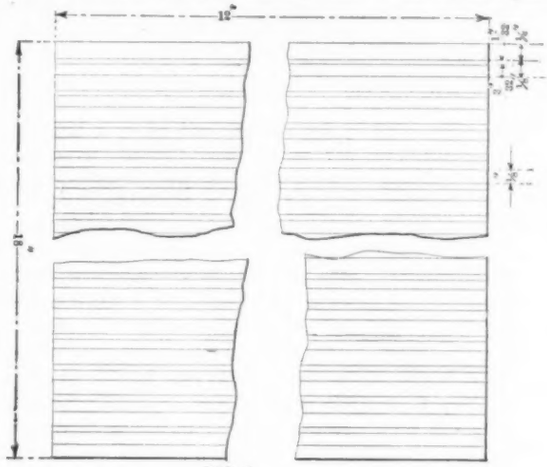


FIG. 1.

FIG. 2.

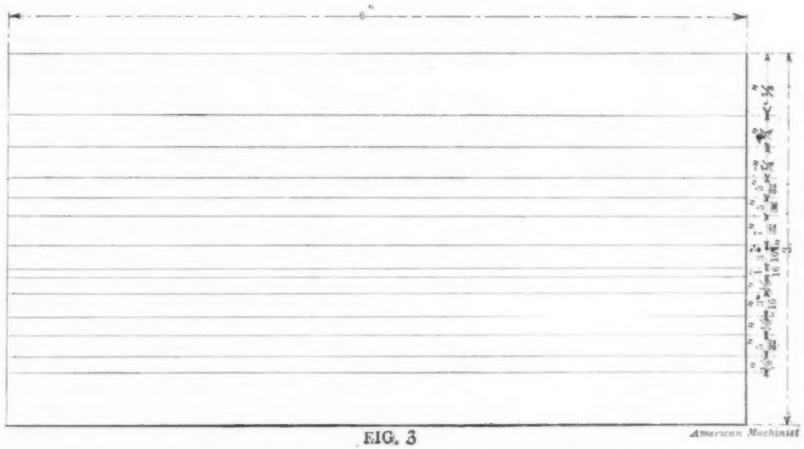


FIG. 3

A METHOD OF SECURING UNIFORMITY OF LETTERING.

First of all, we employ *one style of letters only*. We do not believe in a variety of styles. Each draftsman is given a card with the style of letters on it that we use in our drafting room, with instructions to use that style in lettering his drawings.

This was our first step toward uniformity, our next being to make the letters of the same height. In order to do this and save time, a card was made out of stiff cardboard and lined, as in Fig. 1. This card is used when lettering the tracing. It is slipped under the tracing and lined up with the T-square. When the lettering is finished, pull out the sheet or card, and besides not having any lines to erase, the result is a neat-looking sheet.

When using a heavy grade of bond paper, and it is hard to see the lines of the card through it, we use the instrument shown in Fig. 2. The handle is made of soft pine and three needles are inserted at one end, as shown. The distances between the needle points are the same as those between the lines shown in Fig. 1. In using it, prick small holes in the paper and get the lines from them.

This takes a little more time than the card method, but it saves the time of laying out the lines with a scale, besides insuring uniformity in height.

Fig. 3 shows a card for the sheet title, and is used in the same way as the card shown in Fig. 1.

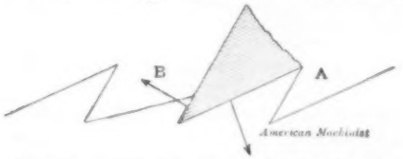
HENRY A. FALONDEAN.

[One of the points necessary to a neat-looking title is that the centers of the various lines of letters shall be in the same vertical line, and we have seen in use in one or two places a method of accomplishing this which is worthy of wider use. The title was first lettered, roughly but with sufficient accuracy to show the length of each line, on a sheet of squared paper, no attempt being made to insure the centering of the different lines. This sheet was then placed below the tracing and the first line of the title lettered in. The sheet of squared paper was then shifted sidewise until the center of the second line on the paper came vertically below the center of the first line on the tracing, and the second line was then lettered in. This completed, the paper was shifted again for the third line, and so on until the title was finished. The additional consumption of time was trifling, and the result was all that could be desired.—ED.]

Machine Filing Versus Hand Filing for Band Saws.

Having noted several articles in the AMERICAN MACHINIST in regard to machine filed saws, possibly my experience along this line will be of interest. This experience covered some considerable time and experimental work, and was rather expensive. It included the development of the band saw filing machine mentioned by "Homo," at page 840, Part I.

At the beginning of the work it was recognized that to produce a commercially successful filing machine two difficulties



SHOWING ACTION OF FILE ON SAW TOOTH.

would be encountered: First, the varying shapes and sizes of saw teeth would, to use any form of file on the market, make a complicated and unreliable machine; and second, to obtain the same keenness of point and freedom from wire edge as is obtained by hand filing, in a machine which must be marketed at a comparatively low figure, would probably be impossible.

In regard to hand filing, some of your readers may not know that the skillful saw filer, by varying the direction and amount of pressure of the file at the end of the stroke, produces a keen edge without turning over the point, a trick which is rather difficult to obtain on a machine, since this pressure must vary with the shape and condition of each tooth. Whether such an edge has been obtained or not can be readily determined by holding the tooth up to the light. The tooth must be bright up to the point, but free from any wire edge or "white caps."

In the machine which was built the first of these difficulties was successfully met by devising a form of rotary file, about 2 inches in diameter, which could

be readily set to conform to any usual shape of tooth, and which was provided on its circumference with a smooth or uncut portion, and a cam motion so applied that the feeding of the saw, tooth by tooth, was effected by the file at the instant the smooth place was passing the tooth. While the second difficulty was not fully overcome, it was in most cases successfully met by taking a second or finishing cut with a sharp file.

A number of machines for small band saws were built and sold, and while giving generally very good satisfaction, as evidenced by "Homo's" letter, they and further experiments on different classes of saws developed a third difficulty which practically killed the further development of the machine. This difficulty contradicts "Homo's" theory. Instead of keeping a uniform tooth, machine filing will eventually develop in places a long and a short tooth, and if such a condition exists, will increase the inequality. That this is a fact has been demonstrated time and again, and the reason therefore can very readily be seen from the sketch.

The resultant pressure of the file acting in the two directions shown by the arrow heads, is resisted by a greater surface on the long tooth *A* than on the short tooth *B* with the result that more stock will be taken off or rather a deeper cut taken off *B* than *A*, given the same pressure. Hand filing can pick out these irregularities and correct them, but the machine which can automatically do this has yet to be invented.

Given a saw which is evenly toothed and the machine will keep it so for a long time, probably longer than any but the most skillful hand filing, and if a person is willing to correct such inequalities by hand occasionally, he can get very good results from a machine, but the machine can never compete with skillful hand work, either in speed or finish.

THE CAPITALIST.

A Split Collar—A Split Ring as a Shoulder for a Saw Flange.

In Fig. 1 is shown a form of split safety collar for a line shaft that has some good features. It is made of wrought iron or steel, or even gray-iron when the strain on it is not too excessive, although the first-named materials are to be preferred. The body *A* is bored to size, and the grooves for the dowel rings *B*, let into the periphery at points diametrically opposite, and rings made of tubing to fit these grooves somewhat tightly, are left rough on the outer ends. The collar can then be split with a thin saw or cutter, when the parts can be put together again and finished to size outside on a lathe mandrel as if the collar were solid. When finished and the mandrel removed, the work can be taken apart by sliding one-half edgewise across the other, which will leave a dowel ring in each half. These can then be easily removed and the hole for the set screw drilled and tapped in about the position shown, which position is chosen because when the screw is tightened the dowel rings receive less direct strain. A headless set-screw being inserted, the collar is ready to apply.

I first made one of these to go on a line shaft where a solid collar could be applied only at considerable trouble and expense. To apply this form of collar it is necessary only to place the halves in position on the line shaft as they were turned in the lathe and drive the rings into the grooves, also in the same position as when turned, and tighten the set-screw. If for any reason you wish to remove the collar, make a wedge from sheet steel and drive under the rings, through the slits, which will readily remove the rings.

The tool for the grooves can be easily and cheaply made, especially if there is any heavy tubing at hand, or even heavy gaspipe would in most cases make rings strong enough for the work, and a short piece of this, with teeth filed on the end, and the diameter slightly reduced and the teeth case-hardened, will make a tool that will wear sufficiently long to make quite a few collars; and where a large number are to be made, of course a tool-steel cutter would be the proper thing. With this tool held in the lathe chuck, and the collar clamped in place of the tool post, the grooves are easily cut in. I describe this process only because it represents some very cheap, or I suppose I should say, inexpensive, tools for producing a good job at a small cost. It is necessary, in starting the tool for the grooves, that the work should be rigidly held until a groove about ⅛ inch deep is started.

Fig. 2 shows another scheme I have used in making a shoulder for a flange on a saw or emery wheel arbor. In making repairs to machinery, I have often come across cases where in the original design of the machine an easy press or shrink fit was depended on entirely to hold the part on the shaft or spindle; and in cases like a lathe head gear, if sufficiently tight to begin with, on account of the large diameter of the gear in proportion to the diameter of the spindle, this is satisfactory; but for some reason it does not seem to be at all times reliable on small flanges, collars, etc., and owing, perhaps, to stretch produced by knocks and strains, they occasionally become loose, and as in the case of the flange for a saw arbor, will slide back. My remedy for this, as shown in the sketch, is to cut

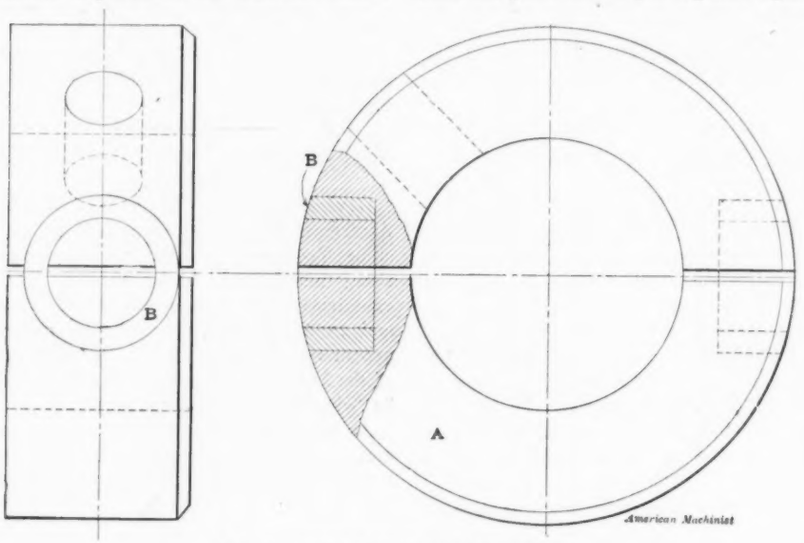


FIG. 1. SPLIT COLLAR FOR LINE SHAFT.

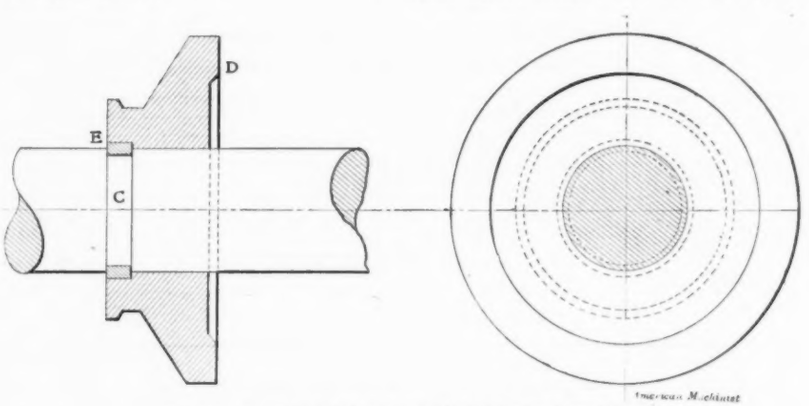


FIG. 2. A SPLIT RING AS A SHOULDER FOR A FLANGE.

the groove *C* in the shaft, counterbore the collar or flange *D* (the cuts need not be very deep in either, say, 1-16 inch in each case), and then make the ring *E*, which is bored, to the diameter of *C* and turned to the diameter of the counterbore in *D*. The ring should be a snug fit in the groove, and after being cut in halves pressed into place.

This method will enable one to use cold-rolled shafting in some places where it might otherwise become necessary to turn up a piece of bar steel in order to leave a small solid collar for no other purpose than this is intended for; and it is much neater and stronger than holding with a pin to prevent a piece moving endwise. I have used it with entire satisfaction in places mentioned, and believe others can make use of this and the split-collar scheme in similar ways.

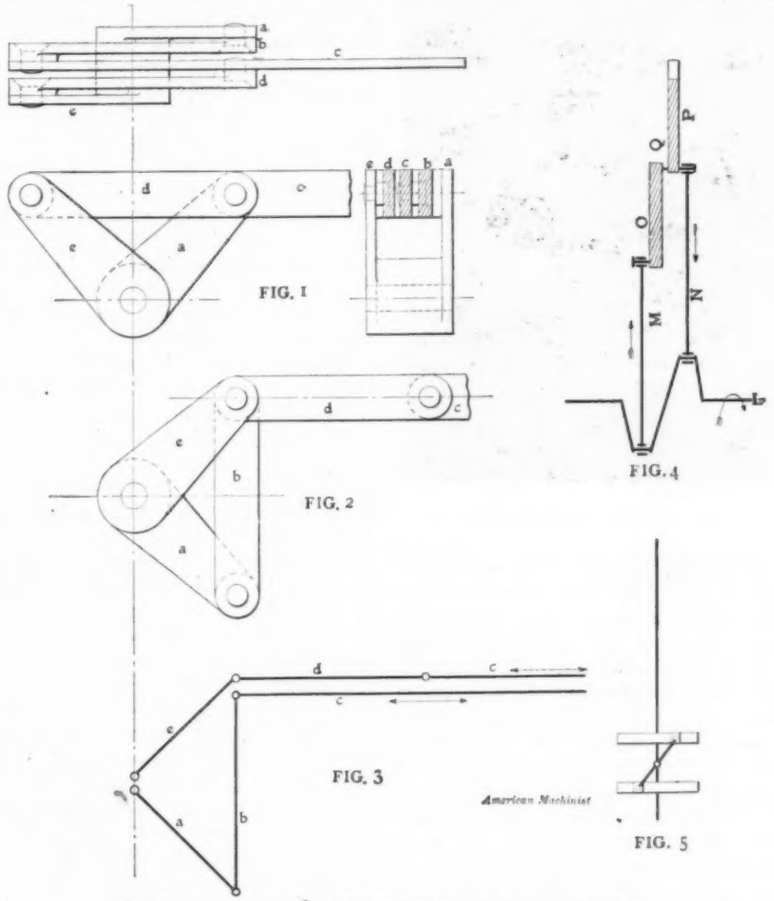
W. M. Fox.

Rotating a Shaft 180 Degrees Without Dead Center.

Unless there is in the sketches accompanying the article under the above heading at page 123 something unexplained, or in the text some hidden meaning which I have not grasped, I fear that in publishing this article your usually so watchful editorial Cerberus has for once been caught napping.

Referring to Fig. 1, page 123, it is not apparent what two double cranks should be wanted for, since only one end of each is connected. What the author meant, I believe, is more correctly shown on accompanying Figs. 1 and 2. The movement described, which is based on supposition that the reciprocating rod *c* travels in a straight line, is totally infeasible. This is clearly shown in my Fig. 3, which shows the proposed mechanism at the end of the stroke, and the two parts of the mechanism separated. It is evident that a slight additional movement of connecting rod *c* to the right would move crank *a* upward. The same movement would move crank *e* downward, and yet *a* and *e* are supposed to be rigidly connected. A movement of *c* to the left, as also can be seen at a glance, would impart very much greater angular motion to *e* than to *a*, which is supposed to be rigidly connected with it.

The scheme proposed is merely a combination of two connecting rods and cranks acting at different angles, and it is quite evident and well-known that they will not act alike.



ROTATING A SHAFT 180 DEGREES WITHOUT A DEAD CENTER.

I remember a very similar and quite costly mistake which was made years ago in a machine (Fig. 4) intended to raise the threads on wood screws, by rotating the blank *Q* between two reciprocating flat dies *O* and *P*. It was attempted to accomplish this by the rotating double-crank shaft *L* and by means of two connecting rods of equal length *M* and *N*. The blanks *Q* were automatically fed into and held by a chuck, which was intended to rotate while the dies *O* and *P* were reciprocated. The machine did not work because the screw blank refused to stay in its place, and was torn out of the chuck. The cause of this is very evident; it could only stay stationary if the speeds of *O* and *P* at every point of the motion were exactly alike and opposite. As a matter of fact, this was not the case, because the crank and connecting-rod mechanism does not move with the same speed at any diametrically opposite points (except at dead centers and when the crank pins are on the quarter). Therefore there was at all times a lateral movement imparted to the screw blank, in the direction of whichever die was moving faster at the time, equal in speed to one-half the difference of the speeds of the two dies.

If, instead of the connecting rods, sliding blocks had been employed (Fig. 5), the machine would have acted correctly. I believe that some such expedient was eventually resorted to.

Carl J. Ulmann.

[As our correspondent remarks, the representation of the cranks *a* and *e* each formed as a bell-crank was a mistake, the extra arms and crank pins being unnecessary—*a* and *e* should, of course, be single cranks. There is one condition which will allow the cranks to be rotated, and that is allowing the rod *c*, besides moving back and forth, to move up and down instead of constraining it to a simple reciprocating motion in a horizontal path. But then the two cranks and the link *b* will move as one solid piece, and the link *d* will move as one solid piece with the rod *c*, and the mechanism will be the equivalent of a single crank with the rod pinned directly to it, and there is no doing away with the dead center after all.—Ed.]

It is stated in Washington dispatches that coinage of gold and silver at the Philadelphia mint is to be suspended indefinitely, the stock of silver bullion being entirely exhausted, and there being at present no demand for gold or minor coins.

The Pennsylvania Steel Company has just been awarded the contract for the superstructure of the new Manhattan Bridge, this company being the lowest of five bidders. Its bid was $7,284,000. The same concern built the superstructure of the Williamsburg Bridge, and is also constructing the one at Blackwell's Island.

The Harrisburg, Pa., school district is equipping an addition to its Technical High School, and will need machine tools and an engine and generator.

A Large Gate Valve of New Type for Low Pressures.

BY JOHN J. SMITH.

The work at a blast furnace is mechanical in very large measure, and is becoming more and more so, but a great deal of it is so specialized that it is not of general interest to mechanical readers but only to those interested in the blast furnace business. Some of the problems which arise, however, are related to those occurring in other branches of industry, and among these is the matter of handling the blast which is simply low-pressure compressed air, but of very great volume, some furnaces requiring as much as 50,000 or 60,000 cubic feet of free air per minute compressed to a pressure of from 15 to 30 pounds per square inch. At smaller furnaces the pressures are generally lower and the volumes less. At the plant with which I am connected the pressure is ordinarily only 3 or 4 pounds per square inch, and the volume per furnace from 10,000 to 15,000 cubic feet of free air per minute. This is handled through 2-foot pipes, and in the problem of distributing the blast from either of the two cylinders of a cross compound blowing engine to either of two furnaces, four valves are necessary, two on each cylinder. Formerly butterfly valves were used for this purpose, but these are troublesome to make and cannot be tight, so that they are very undesirable. A type of valve has been developed for this service in which the spindle is threaded for a small portion of its length, only 6 or 8 inches. This is sufficient to force the valve from its seat, so as to allow the pressure to partially equalize on both sides of it, and the valve can then be withdrawn the rest of the way by hand; similarly in closing, it is pushed up by hand until the thread engages and is then forced to its seat by the latter; these valves of course being of the "gate" type.

When the occasion arose for the four valves just mentioned, a prominent manufacturer was written to for prices and information. He replied offering to make four valves of the type outlined for something over $600. This price was thought to be very high, and I decided to have them designed and made locally, which was accordingly done for just $400. It may be said that I had never designed a valve of this type and size before, and was in some doubt as to how it should be made absolutely tight all around the face of the disk. If any sort of wedge were applied at one point there would be no sufficient guarantee that the valve would be forced into close contact with the seat at all points, and if more than one wedge or its equivalent were used, it was more than doubtful whether all of them would bear equally at the same time. It should be stated also as one of the conditions of the design, that it was desired to keep the valve the smallest possible in the dimension of length, or face to face measure, as well as in the financial dimension. It was also desired to make it of a type which could be handled by the tools of an ordinary repair or jobbing shop. Accordingly instead of making a cylindrical body with the faces for the gate in a recess in the center and the flanges on necks long enough to separate them from the body proper, it was decided to put the joint or seat face on the inside of the flange itself. In order to get the bolt circle the same as the standard on the other pipes, the faces were made slightly beveled inward, so as to give room for the seat face and still allow for this condition. This, of course, obstructs the area to a very slight extent, but the effect could not be determined by any instrument of which the writer has knowledge.

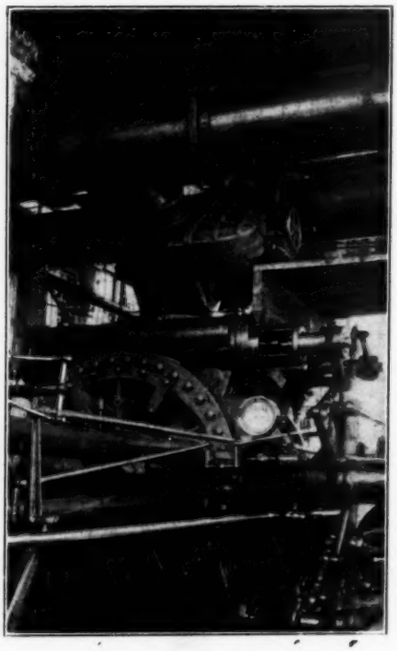


FIG. I. GATE VALVE IN USE.

In order to secure proper contact between the valve and seat, it was finally decided to make the valve with two separate disks, and to force these apart at points as nearly uniformly distributed around their periphery as possible. In order to do this uniformly some form of equalizing device was necessary, and the scheme of long nuts operating toggle joints shown in the drawing was finally adopted as the solution. The nuts are long double cones, the outer ends of which constitute the center pins of the four toggle joints, the screw passing through the nut at right angles to the axis of the double cone. The outer ends of the toggles are pinned to ribs on the valve disks. The screw which goes through one nut is right hand, while that going through the other is left hand, the pitches being the same.

It must be remembered that the valves are intended to be opened and closed entirely by hand, the handle being turned only to force the disks against their seats. A little consideration will show that the toggles are equalized almost perfectly against one another. The nuts are not fitted very tightly to the thread so as to allow them to have a little play at the ends, and in this way each nut becomes more or less of an equalizer, while as against each other they are perfectly equalized, for the reason that they pull only against one another, and if one nut forces its pair of toggles out and brings the valve disks to a bearing on that side, that nut will then come to rest until the other nut has traveled far enough to bring an equal tension on its pair of toggles, and so force the other side of the valve disks to an equal bearing on their seats. This at least was the expectation, and it has been amply fulfilled in practice. Before the valves were mounted in the pipe they were operated and inspected for tightness, with the result that it is impossible to conceive of any better joint of that character than they made. The equalized action seemed to be perfect in all directions, while the pressure which could be obtained from the toggles is so great that it is not improbable that the valve disks could be burst by it.

Over all the lower half of the seat face the valve body proper makes an absolute reinforcement of the stiffest description; but over the upper half this is not the case, and to overcome this difficulty heavy ribs were run from the bonnet-flange of the valve down, just as close to the face of the pipe flange as they could be allowed to come. Of course at the upper part the great stiffness of the bonnet-flange parallel to its face had the desired effect without any further addition, although it was made full width on this account.

The bonnet presents quite a large, flat surface, which is always subjected to the full pressure on the main, and it was necessary to stiffen this, which was done by external ribs. There are also provided two shallow internal ribs slightly wider apart than the valve faces, which serve to guide the valve when being pulled in or out, the axis of the valve being horizontal and their central plane being inclined transversely, as shown very plainly by the photograph. It will be observed that the four top holes in the pipe flange came at such a point as to bring its bolt heads inside the valve body, which necessitated taking off the bonnet in order to insert these when putting the valve into its place in the pipe. This was foreseen and was endured because I have a deep-rooted objection to studs in cast iron. Nevertheless in the present instance studs would have been justifiable not only because they would have saved this work of dismantling the valve in order to erect it, but also

because the pressure being all around the belt heads, they were not made tight by an ordinary internal gasket, such as the writer always uses in ordinary work of this kind, and grummets were required under them.

stem should be so located that the ordinary right-hand rotation for closing the valve will be the proper one for tightening a valve of this type. No attention was paid to this matter on the present valves, and of course the threads happened to

of even four or five pounds per square inch comes on the area of a two-foot pipe, the aggregate is large, and the friction of starting the valve from its seat considerable. For the present purpose this is not objectionable, but if the valves were to

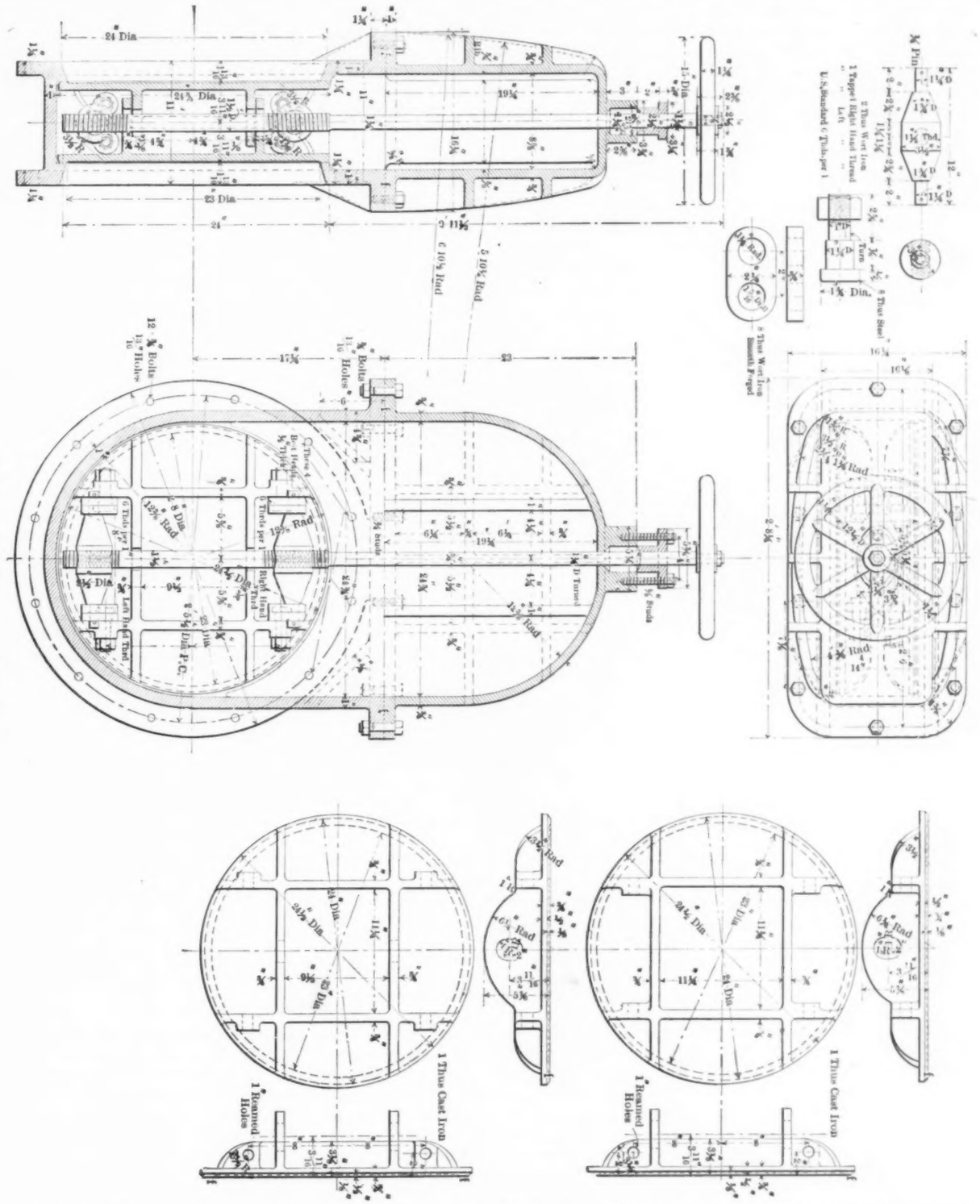


FIG. 2. CONSTRUCTION OF GATE VALVE.

In practice, as before stated, these valves have given entire satisfaction, but one or two points may be noted for the benefit of those who may desire to use the design. The right- and left-hand threads on the

come so as to require left-hand rotation of the wheels to tighten the valves, and a right-hand one to release them, which is a great nuisance.

Another point is that when a pressure

be used frequently a slight change in design should be made so that a screw would force the valve from its seat and draw it to its seat *after* and *before* the locking and unlocking operations, respectively.

This would not involve the necessity of another hand wheel or much additional mechanism.

The practical reason for describing this type of valve is, apart from its novelty, that the four equalized toggles furnish a means for forcing the valve disks to their seats, which is very simple and which leaves nothing to be desired in point of effectiveness. Of course the feature of putting the seat face on the inside of the flange is merely incidental, and is not a necessity of the design, which, in fact, would be much more easily made without this condition.

For higher pressures the same construction could be used, but in that case the modification of the design for moving the valve disks by a screw should be extended so that their entire travel would be accomplished in this way—not a very difficult matter.

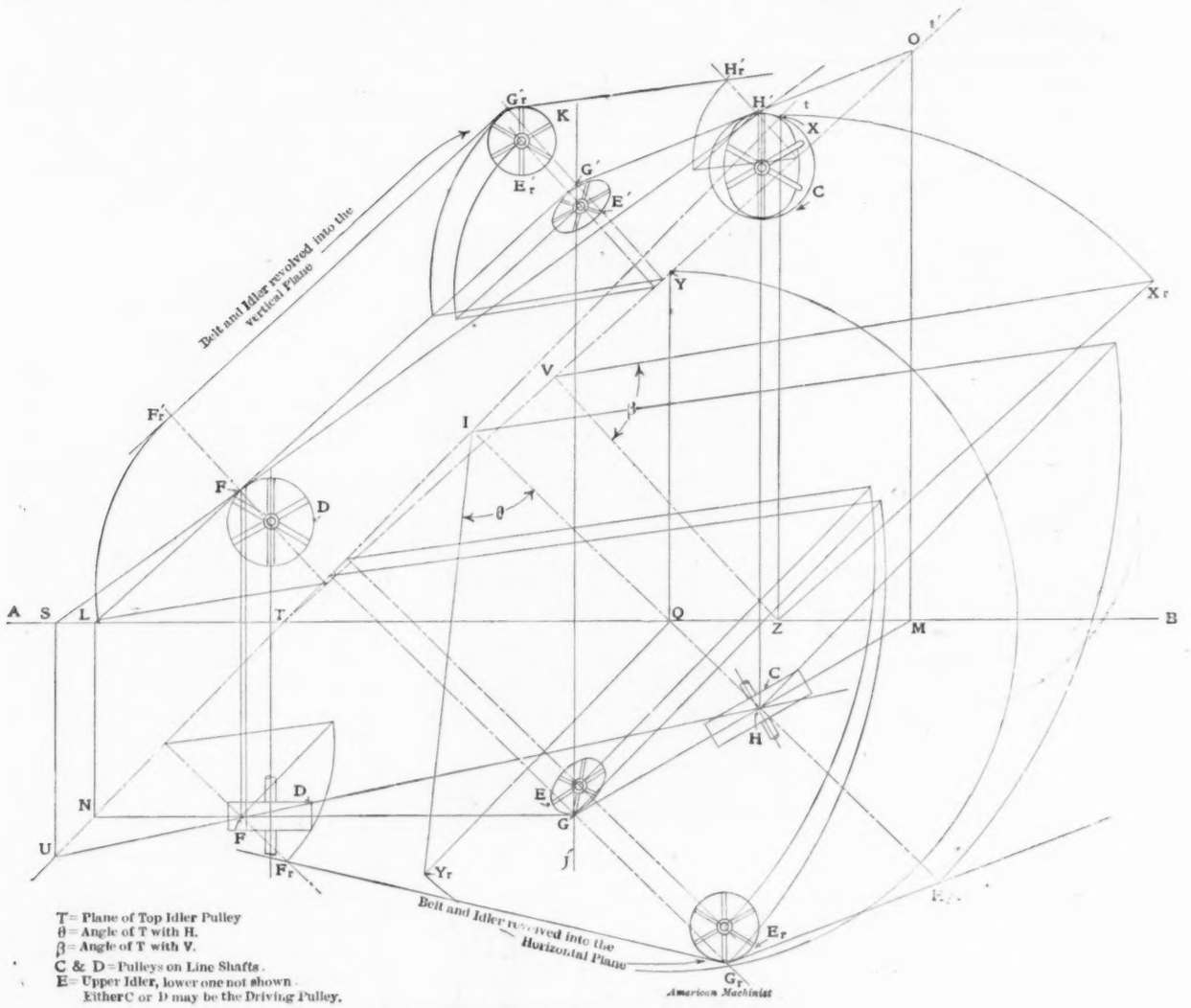
There seemed to be a good many men at the reciprocity convention in Chicago who could not forget their politics and take a business view of the situation.

Determining the Position of Idler Pulleys for the General Care of Belt Transmission.

BY R. N. MACALISTER.

The purpose of this article is to relieve, if possible, some of the difficulties of the draftsman when called upon to design a belt drive for transmitting power between shafts whose axes are not parallel. The difficulty which presents itself in the solution of this problem is that of determining the position of the idler pulleys in order that the belt may run in either direction, that is, either pulley may be the driving pulley. Now, the necessary and sufficient condition that must obtain in order that the belt remain on the pulleys during revolution in either direction is that wherever a belt is running on to a pulley the center line of the advancing belt must lie in the central plane of the pulley on to which it is running; *i. e.*, in a plane normal to the axis and passing through the center of the pulley. If we keep this condition in mind, and apply our descriptive geometry, the solution of the problem becomes comparatively easy. I have taken the case where the axes are not parallel and not in the same horizontal plane, this being the most general case and the most difficult of solution, although the principles evolved apply as well to any case of belt drive. In this discussion the usage of descriptive geometry, in denoting the projections of points by letters, has been followed, although the capitals rather than the small letters have been used for the sake of clearness; *e. g.*, *H* denotes the horizontal projection of a point on the pulley C, and *H'* the vertical projection of the same point, while H_r or H'_r denote the point revolved into the horizontal or vertical planes.

Referring to the drawing, let the line *A B* represent the intersection of the floor with one of the walls of the building; then the floor will represent the horizontal plane and the wall the vertical plane, with *A B* as the ground line. Now, draw in the horizontal and vertical projections of the driving and driven pulleys *C* and *D* in their proper positions to scale, and draw the lines *F G* and *G H* to represent


Belt and Idler revolved into the Vertical Plane
Belt and Idler revolved into the Horizontal Plane
T = Plane of Top Idler Pulley
θ = Angle of T with H.
β = Angle of T with V.
C & D = Pulleys on Line Shafts.
E = Upper Idler, lower one not shown.
Either C or D may be the Driving Pulley.
American Machinist

FINDING THE POSITION OF IDLER PULLEYS.

the belt in the central plane of the pulleys. The intersection of these lines is the point where the idler pulley must touch the belt to guide it properly. The vertical projections of these lines $F'G'$ and $G'H'$ must intersect on the line JK, drawn perpendicular to the ground line AB through the point G. The point G' may be taken as any point on the line JK, this being governed somewhat by the conditions in the building as to height of ceiling. Having determined the points, F, G and H, at which the belt is tangent to the pulleys, a plane passed through these points is the plane in which the idler pulley must lie in order to fulfil the given condition. To determine this plane tTt' produce the line $G'F'$ until it intersects the ground line at L. Drop a perpendicular to the line GF at N, also produce GH to M and erect a perpendicular to intersect $G'H'$ at O. This gives two points, O and N, in the traces of the plane. One more point is necessary, which may be obtained in the following manner: Take the points on the pulleys C and D, H' and F', and produce a line through them, intersecting the ground line at S. From S drop a perpendicular to intersect the horizontal projection of the same line HF at U, this being the required point. Having these three points, O, N and U, the traces of the plane tTt' can now be drawn. It is next necessary to determine the position of the center of the idler pulley. This is done by revolving the plane T about its horizontal trace, F_r G_r and H_r being the points of tangency, F, G and H in their revolved position. Draw the lines F_r G_r and G_r H_r to represent the belt in its revolved position, and bisect the angle F_r G_r H_r. The center of the idler in its revolved position must lie on this bisecting line. Therefore, after the diameter of this idler has been determined, it can be drawn to scale tangent to the revolved belt line, as shown at E_r. Revolving the plane T back to its former position shows the projection of the center of the idler in its true location. Next revolve the plane about its vertical trace into the vertical plane, and draw the vertical projection of the idler pulley in the same manner as shown at E'_r. By revolving the plane back as before, the vertical projection of the idler center will be obtained. Since the idler pulley lies in the plane T, its angles relative to the floor and walls of the building, or what is the same thing, the horizontal and vertical planes, may be obtained by passing the auxiliary planes IQY and VZX perpendicular, respectively, to the horizontal and vertical traces of the plane T, and revolving the plane IQY about IQ into the horizontal plane, and the plane VZX about VZ into the vertical plane, thus obtaining the angles θ and β which the idler makes with the floor and wall of the building. The height of the idler center, and its distance from the wall and also the distance from the shaft of pulley D, can be scaled from the drawing, remembering that the ground line AB represents the junction of the wall and the floor. Having these dimensions and the angles θ *and* β, the position of the idler to fulfil the conditions of the problem is definitely determined. In this drawing only one idler pulley has been shown, although it is, of course, necessary that there should be two of these idlers on the belt, but since the method for determining the position of the one other than that shown is exactly the same, it is hardly necessary to show it in position, or to take it up in the discussion, it being much clearer to refer to but one of them.

Rolling Weldless Tubes From Rods.

The manufacture of seamless tubes by rolling has taken root, but as heretofore carried on there have been some disadvantages, one of which the arrangement here illustrated is designed to remove. The principle in the new as well as in the old system is, that the instant the inclined rolls grasp the piece the outer layers are worked lengthwise and the inner ones worked outward from the conical-ended core. In the old method, however, where the blank is a cylindrical rod of equal diameter throughout, the influence of the rolls and the formation of the tube begins only when the end of the rod has entirely or almost reached the conical point of the core. For this reason the entrance of the core in the piece meets with considerable resistance. In order to reduce this to a minimum the old process called for the removal of a portion of the axial center of the rod so as to enable the core point to enter as soon as the piece was presented to the rolls. The new process calls for a special shape of the entering end of the rod; it being upset conical or spreading, as shown in Fig. 1, where *a* is the rod with spread end, *b* and *c* the axially inclined conical rolls and *d* the core. This has the double advantage of giving the rolls a larger diameter to grip and of enabling them to rotate the rod somewhat sooner in its passage toward the core than by the old process. Fig. 2 shows in section a further stage of the process. The inventor, Herr Otto Heer, of Düsseldorf, claims that it is also advantageous to upset the other end of the rod in the same way to insure equal diameter of the walls clear through the entire length of the tube. (*Zeitschrift für Werkzeugmaschinen und Werkzeuge.*)

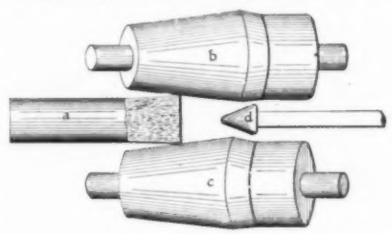


FIG. 1.

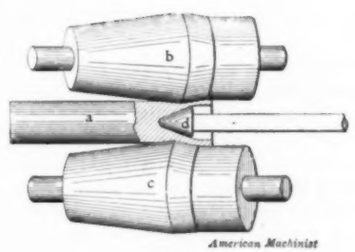


FIG. 2.

ROLLING WELDLESS TUBES FROM RODS.

Efforts to Extend Our Foreign Trade.

The Department of Commerce and Labor is desirous of securing the co-operation of manufacturers and other persons interested in the efforts making by the Department, through the Bureau of Manufactures, to extend the foreign trade of the United States. In furtherance of this work, it is proposed to establish a comprehensive card index, which will enable the Department, upon application, to furnish information desired by manufacturers, or by intending purchasers, and it is contemplated to extend the system, if the necessary authority shall be granted by Congress, to our principal consulates. To enable the bureau to prepare such an index, a circular has been sent to manufacturers and exporters with a request to fill in the accompanying blank and to give any additional nformation which the recipient may desire to have recorded in connection with his business.

The Largest Friction Board Lift Drop Hammer.

At the works of the Billings & Spencer Company there is under construction a 5,000-pound drop hammer, ordered by one of the largest steel companies in America. The weight and dimensions of this drop hammer are believed to be in excess of those of any other drop hammer of this class in the world. The base weighs 72,526 pounds. The hammer weighs 5,000 pounds. The uprights weigh 7,600 pounds each. The friction rolls weigh 1,200 pounds each, and the roll spindles, rolls, gears and oil guards are one-piece forgings. The hammer, rough planed, weighed 5,600 pounds. These forgings were made by the Bethlehem Steel Company. The shoe forging weighs 2,240 pounds, and the shoe key weighs 160 pounds. Dimensions of driving pulleys are 60x13x4½ inches. The length of rear roll shaft is 94 inches; of front roll shaft, 60 inches. Distance between point of ways, 30 inches. Extreme fall of hammer, 6 feet 4 inches. Total weight of machine, 125,000 pounds. The Billings & Spencer Company have made 450 drop hammers of various sizes. The drop hammer department is running night and day, employing two sets of hands engaged in making hammers for foreign countries.

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A Businesslike Proceeding With Respect to Charges for a Public Service.

We have before us a report which is in many ways remarkable. It is entitled "An Inquiry Into Telephone Service and Rates in New York City by the Merchants' Association of New York, June, 1905," and it contains the record of what was done by the association named in coming to an understanding with the company which controls the telephone service of New York, and which, by means of its control of the conduits through which wires must go, if at all, in New York, effectually prevents the possibility of competition.

As many of our readers know, the company referred to had for a long time charged for telephone service prices which, to many would-be users, were simply prohibitive—prices much higher than those charged in other cities. These high charges the company always attempted to justify by statements to the effect that the more subscribers a telephone company had the more the service to each subscriber cost the company, and that as there were many subscribers in New York, therefore the prices for the service must be high.

Rightly or wrongly, this was not satisfactory to New York people generally. They continued to complain and to agitate. They made repeated efforts to organize and put into operation competing companies, all to no purpose. The telephone company was able to block the game because it controlled the conduits, and in order to break this control legislation would be needed at Albany, which legislation either was not to be had or would cost too much.

Finally the Merchants' Association took up the matter, and so vigorously did they go about it that it seemed for a while as though the Legislature might actually have to yield and enact a bill in the interest of the people of New York, for the Merchants' Association is composed of men who are not accustomed to being poohpoohed. They are men who are in the habit of doing things, and their association had performed valorous feats in connection with a proposed "Ramapo" water scheme, had secured the attention of the most high and mighty railroad officers, and had even tackled and partly tamed the New York cab driver. After going far enough into the matter to satisfy itself that fair charges for New York could not be fixed by reference to charges in other places, the special committee of the association arranged for a thorough examination by a public audit company, which reported as to the profits that had been made during a term of sixteen years, these profits being based, not at all upon stock issued, dividends paid, or bonds outstanding, but upon the relation of clear earnings to the capital really invested in the business, *i. e.*, the value of the company's plant and fixtures. Figured upon this basis, the profits did not appear to be as great as it was expected they would, but they had been rising, were at the time of the investigation something over 14 per cent., and a substantial reduction in telephone rates was agreed to and put in force.

Thus the principle that a telephone company is not a private concern; that, being in exclusive possession of its field, it has not an undisputed right to charge what it can get for its service, was recognized and, at the same time, the evils necessarily attending the installation and operation of a competing system were avoided. There can be no question that two or more telephone companies covering the same field is an awkward, wasteful and altogether undesirable way of securing fair rates for users. In many foreign countries the government (general or local) controls the business. This New York plan is a new departure, so far as we are aware, and has much to commend it. There is, however, nothing compulsory about it, and generally speaking, it is probable that there would have to be a pretty strong public sentiment in favor of doing something, and a pretty strong probability of that something being actually done, before a telephone company would be convinced that it was under any obligation to listen to the appeals of citizens for more reasonable rates.

Many of our readers, manufacturers and others, are interested in one way or another in telephone charges, and the question of their regulation. They can do no better than to study the report mentioned. It gives an account of what appears to us to have been a particularly rational and a thoroughly businesslike proceeding.

New Publications.

"Cams and the Principles of Their Construction." By George Jepson. 59 6x9-inch pages with 37 illustrations. The University Press, Cambridge, Mass.

This is a welcome addition to the limited quantity of literature on cams. The methods employed do not differ essentially from those explained in the articles by Mr. Smith, which appeared in our columns recently. The book is useful and practical and will form an excellent addition to any draftsman's library.

"Catalogue Officiel des Collections du Conservatoire National des Arts et Métiers." 439 5½x8⅝-inch pages, with numerous illustrations. E. Bernard, 29 Quai des Grands-Augustins, Paris.

The museum of the Conservatory of Arts and Trades, Paris, is devoted to industrial and scientific exhibits. To list its collection six volumes of the new catalogue will be required; this volume, though it is very sizable, being limited to the mechanical exhibits. To judge from the mere outline here afforded, the place must be a

perfect paradise for a machinist, and worth almost a trip across the ocean to visit. Some of the pictures show busts of famous mechanics, but more of them show machines. There is quite a long introduction, giving an account of the origin and growth of the institution.

"The Book of the Automobile." By R. T. Sloss. New York; D. Appleton & Co. 372 6x8-in. pages, with 148 text cuts and numerous full-page plates.

This is a semi-technical, readable book intended for the intending purchasers of automobiles. It gives the principles of construction of the different classes of machines with sufficient fulness for its intended readers, and follows this with chapters on how to choose, how to run and how to care for an automobile, of which the last two especially will be found to be instructive. Other chapters relate to the automobile in commerce and sport and to touring. An appendix gives a résumé of automobile legislation and the Gordon Bennett racing rules. The book contains a liberal amount of the chit-chat which is to be expected in a book of this character, but with this is a good supply of the information which the average automobile owner needs and wants.

"Electrician's Handy Book." By T. O'Connor Sloane. 761 4½x6½-in. pages, with 556 illustrations. The Norman W. Henley Publishing Company. New York. Price, $3.50.

This is a condensed, comprehensive, non-mathematical, descriptive handbook of electrical machinery and apparatus, and it will be found useful by central station men and others desiring to learn the action and properties of various kinds of machinery in their charge. All important classes of station, power and lighting machinery are covered. The book is printed on thin paper of good quality and is hence compressed to a moderate size.

"Proceedings of the Society for the Promotion of Engineering Education." Vol. XII. 253 6x9-inch pages. Engineering News Publishing Company, New York.

Among the more important papers and discussions which are included in this volume are the teaching of the history and biography of engineering, the crowding of the curriculum, the extension of investigational work, field work and the preparation of engineering text books.

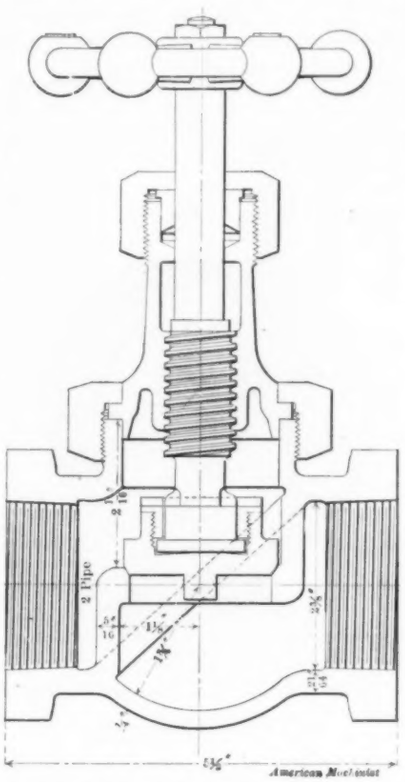
The battleship *Kansas*, a 16,000-ton vessel of the same general dimensions as the *Connecticut*, now nearing completion at the New York Navy Yard, was successfully launched by the New York Shipbuilding Company at Camden on August 12.

Foreign goods bearing a trade mark protected in Germany, no matter how long the foreign firm may have used that mark, are liable to seizure on importation there.

New Tools and Machine Shop Appliances.

IMPROVED REGRINDING VALVE.

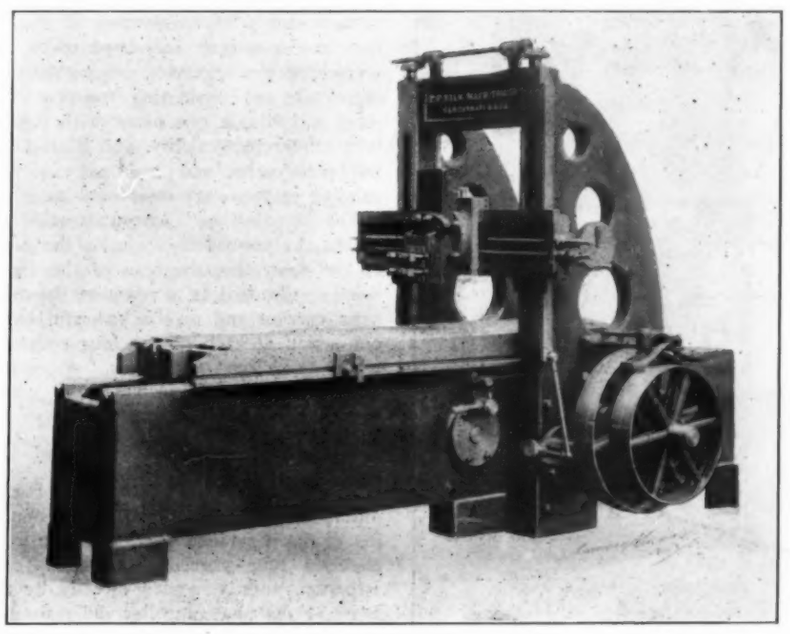
This valve is clearly shown in the accompanying line engraving, and by referring to the illustration it will be noticed that the hub which carries the operating stem is secured to the body by a union connection, which, in turn, screws over the shell of the valve body. This construction prevents hub and body becoming corroded together, as the thread which holds the union ring to the body is protected at all times from the action of the steam, the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body and tends to strengthen the valve. The disk is held loosely to the stem by means of a lock-nut and will adjust itself to the seat readily to form a tight joint. To regrind the valve, the bonnet ring is unscrewed and the fittings are removed from the body. A wire or nail is placed through the lock-nut and stem, a little powdered sand or glass and soap or oil are put on the disk and the parts are again placed in the valve and reground. The bonnet has a small rim or projection on the bottom, which acts as a guide on the inside of the valve neck while regrinding. The seats on the valve-bodies are very small when the valves are sent out, thus permitting of considerable regrinding. The valve can be packed under pressure when open or closed and to pack while the steam is flowing through the valve, the latter is opened as wide as possible when the shoulder at the top of the stem thread forms a seat beneath the stuffing-box. The medium pattern valves are made to stand a working pressure of 200 pounds per square inch and the extra heavy pattern up to 300 pounds per square inch. The Lunkenheimer Company, Cincinnati, Ohio, are the makers.



SECTION THROUGH 2-INCH REGRINDING VALVE.

PLANER.

The half-tone represents the 24x24-inch by 6-foot size of a line of planers built in



PLANER.

various sizes up to 30 inches. The bed is of ample depth, with double-webbed box girts, closely spaced, and has pockets and rollers for oiling the platen. The housings are of box form, and the cross-rail, which is well arched and ribbed behind, is fitted with single or double heads as required; in the latter case an improved disconnecting device being applied for independent feed. The vertical-feed mechanism is provided with a graduated collar reading to 0.005 inch, and the graduations for angular settings read to 45 degrees either way. The friction for controlling the feed is arranged to release automatically each time after its duty is performed, thereby relieving it from wear and preventing heating, and a simple device is utilized for shifting the belts. The bull-wheel shaft runs in flanged bearings, doweled and bolted to the bed. The loose pulleys are provided with Arguto oilless bearings. The driving shafts run in long bearings, readily oiled; and the gears running at highest speed are made of bronze. The countershaft has a large balance-wheel for equalizing the shock of the reverse, is fitted with 16x5-inch tight-and-loose pulleys, and is carried by adjustable hangers fitted with wick oiling boxes. The builder is the P. P. Silk Machine Tool Company, Cincinnati, Ohio.

NEW CRANE CONTROLLERS.

The accompanying illustrations show two new types of controllers for crane use which are the product of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis. In their design, the aim has been to provide as simple a construction as is consistent with proper control, to provide as few points as possible at which arcing can occur, to make certain that such arcing as does occur will be under predetermined conditions and with ample protection, and to provide for any renewal of injured parts.

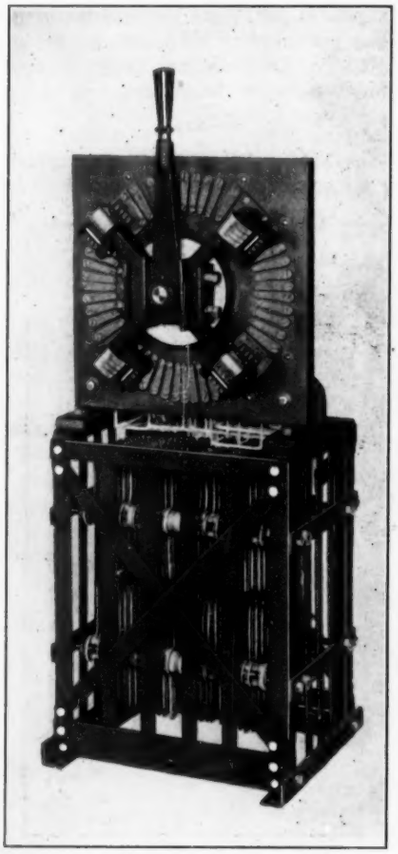


FIG. 1. TYPE B CONTROLLER.

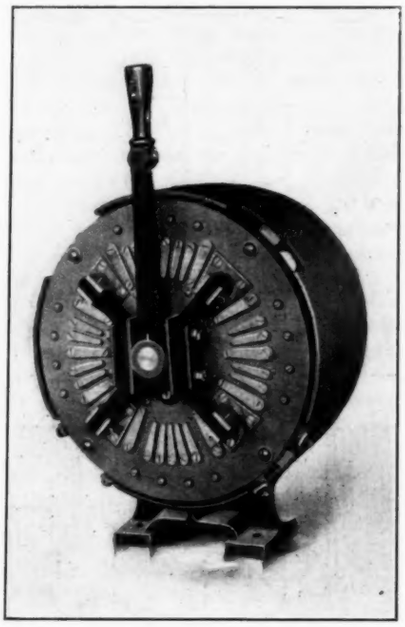


FIG. 2. TYPE A CONTROLLER.

Fig. 1 shows the type B controller, in which the front is mounted above the resistance, thus making the connections on the back of the slate easy of access. Four sets of segments are provided, which are so connected that no reversing sector is necessary. The resistance is also in four sections, each connected to its respective sets of segments, making the wiring simple and eliminating crowding. The lever is made in one piece, with jigs to insure interchangeability, and is then cut into three parts, and large pieces of insulating material are inserted.

The blow-out coil surrounds and embraces the controller shaft on the front of the controller, the iron of the frame being so disposed as to complete the magnetic current and give a powerful blow-out action at each of the four points at which the circuit is broken. A reliable centering device is provided by which the operator can feel the central or off position without, however, preventing quick reversal.

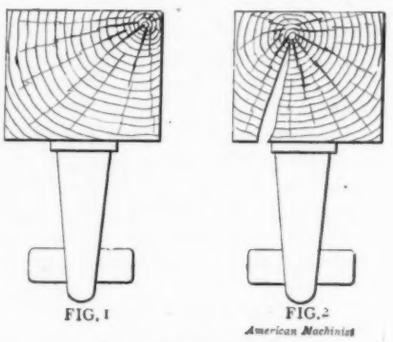
The type A controller, shown in Fig. 2, differs from the above only in the mounting of the resistance, which is of the iron-enclosed - tube - porcelain - insulated construction, and is carried directly by the front, so that the controller and resistance may be removed from the case and mounted in a recess for small trolley hoist work, etc., or it may be rotated within the case for suspension from the top or sides of the crane cab. It may also be arranged for rope operation from the floor.

The resistance provided will give a speed reduction of 50 per cent. under average load conditions. The contacts may be removed from the front without disturbing the connections at the rear.

College Shop Experience—II.

BY HARRY MARQUETTE.

On the first day of the fall term the new shop professor, dressed in his overalls, was putting some finishing touches on the toolroom, when in strutted a little coxcomb, the kind of fellow that is about 5 feet 4 inches high, weighs 115 pounds, and is just bursting with importance. He was immaculately dressed, and his domineering manner showed in every action. The two men stood looking at each other for a few seconds, and then the new professor advanced and offered his hand, saying, "I suppose you are the professor in charge of the department of mechanical engineering, which includes the shops." He was given to understand in no uncertain tones that he was correct in his surmise, and then subjected to a rigid examination as to how thoroughly qualified he was to carry on the work. One of the first questions was, "Do you hold an M. E. degree?" And upon receiving the new man's answer to the effect that he was only a Bachelor of Mechanical Engineering, the little fellow swelled still bigger; but before fifteen minutes of the examination had progressed, "His Nibs," as the newcomer irreverently named the little fellow in his mind, displayed the fact that he had never done a day's work in the shop in his life, and in fact boasted of it. It also turned out that his lack of shop practice was in-



HANGERS ON BEAMS.

finitely more than balanced (in quantity) by his feeling of self-importance. As His Nibs showed a tendency to become a meddlesome nuisance, the new professor adroitly got rid of him for that day by asking information on a lot of things concerning which the small man was ignorant. As he went out, however, he said, "I will be around every day to give you any information you need and to advise

you as to the method of carrying on the work." It may be interesting to know that His Nibs was a rich man's son, who had failed to pass through one of the larger colleges, and could only secure his M. E. degree from a weak and little-known institution, at which he did very little work but spent a good deal of money. Rich relatives with a political pull landed him in his present position.

After the exit of His Nibs the newcomer set about getting the material ready for the wood-working classes, which were to begin work that afternoon. Fortunately for him, the previous classes had worked with 3-inch stock for their framing exercises, and had dressed it down to 2¾ inches. There was a large collection of these old exercises on hand, and this was practically the only available stock of timber with which to start the classes. For this reason new exercises had to be designed. a tracing made for the first

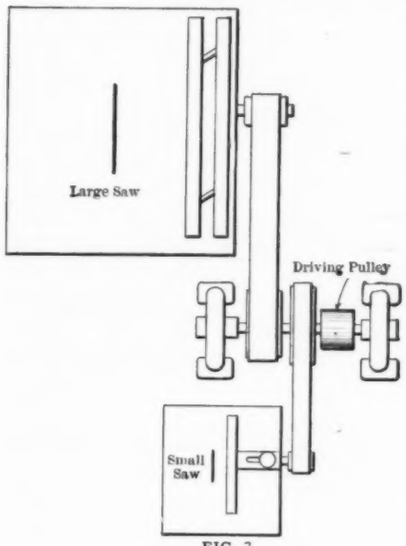


FIG. 3
American Machinist

SCHOOL-SHOP ARRANGEMENT OF SAW TABLES.

exercise, and the necessary blueprints gotten out. Later, after the shop got into running condition, the making of the blueprints became a part of the duties of the boys in charge of the toolroom.

The electric power was put on about 9 o'clock in the morning for the first time that fall, and before the class showed up the professor started his electric motor to try his shafting. In the woodroom there was a 2-inch shaft, which was 14 feet between hangers. Near the center of this span there were two pulleys, one 40 inches in diameter and one 38 inches, for driving the circular saw and the sticker. Both these pulleys had very tight belts over them, and the combined weight of the pulleys and strain of the belts throughout the three months of summer idleness had put a permanent set of about ⅜ inch into that shaft, so that when the machinery started those pulleys gave an exhibition of shaking things that was not altogether calculated to make one feel safe in that end of the plant.

Before this matter could be adjusted, or even considered, the boys came on the scene. Fortunately, the morning period was taken up with a general talk. One or two of the boys who had no recitations the next hour offered to stay and help turn that sticker and saw around so as to get the pulleys next the hangers, but about that time the president and His Nibs showed up, asking what was going to be done, and when the matter was explained to them, the new man found out that there was trouble ahead, for he was given flat-footed orders that under no circumstances was he to change the location of a single machine tool in the plant, and the president backed up the order.

As soon as the invading pair had retired, the "Prof.," as the boys had promptly named the newcomer, proceeded to the only alternative he had, which was to resort to strategy. The pulleys under consideration were large, rather heavy wooden pulleys and by removing their wooden bushings and arranging new ones ⅜-inch out of center, and then locating the pulleys in such a position that the center of the pulley was where the center of the shaft ought to be, the majority of the eccentric jumping was gotten rid of. But anyone who has had experience in the lining up of crooked shafting will have some idea of how the three boxes on the line of shafting behaved themselves.

As stated in a previous article the roof of the shop was supported upon 14x14-inch fir timber. Now, fortunately or unfortunately, the Oregon fir grows so big that 14-inch timber can be gotten out in almost any portion of the log in relation to the heart, and anyone who knows anything of the warping of wood will realize that this would have quite a marked effect on the problem of where the hangers would go; for instance, when the heart was located as in Fig. 1, the box would have a tendency to tip up on the right side and down on the left. When the heart was located as in Fig. 2, and the timber happened to split open as shown, which was the case with many of the pieces, the box would be carried still farther to the right. When the heart was anywhere inside of the timber, it was almost sure to have big cracks in it running to the surface, and these greatly influenced the manner in which the surface of the timbers moved. In some cases this cracking had amounted to a shifting of the hanger more than ⅛ inch. As a consequence the shafting was badly out of line. It was carefully lined up, but later on the rainy season came, the air became full of moisture, which these cracked timbers absorbed, and all kinds of changes followed. The professor was finally willing to "let her run" as long as she would keep turning and plenty of oil would keep her cool.

The artist who placed the saws originally, arranged them as shown in Fig. 3, in which it will be noticed that both saws are driven from one jack-shaft located on the floor, and that the little one is almost in line with the big one. By doing some repair work at a sawmill, and taking his pay in lumber, the "Prof." succeeded in securing a very choice lot of Western bull-pine plank, consisting of three pieces each 40 inches wide, 2½ inches thick and 20 feet long. It was necessary to saw these up into convenient sizes for students' exercises. While guiding one of these big planks across the big saw table, it had to be carried across the small saw table. The designer had very thoughtfully placed the three pulleys on the jack-shaft side by side, and so close together that it was impossible to throw the belt for the small saw off and stop the saw, in other words, when the jack-shaft was going, both saws had to go.

In managing these big planks across the small saw table onto the big one, a clumsy freshman slipped on the sawdust, fell down, and knocked the "Prof." on to the small saw table. The ugly little saw proceeded to take off a good part of his jumper sleeve and some of the cuticle above the elbow. While the accident was not serious, it was sufficient to raise an insurrection in the shop, which resulted in the offending lumber racks being banished to another room, and a completely changed arrangement of the machines, so that all pulleys came close to hangers, and also so that each machine could be started or stopped independently of the others.

After the revolution had progressed to such a point that the shop was running successfully once more, His Nibs blew in. Upon seeing the changed arrangements of the tools, he flounced out and returned with the president, and they two proceeded to tell the professor what was what; but a man with his jumper sleeve slit off by an ugly little saw and more or less cuticle missing is not likely to be very tractable, and only the small stature of His Nibs and of Prexy prevented the revolution continuing from the machinery to the faculty, and resulting in an eviction; as it was, considerable was said that might not appear well in print, and finally the two injured members in authority marched out with a few uncomplimentary remarks about "dirty mechanics" and "shop-trained men."

Wm. Schmidt, who had a general repair and jobbing machine shop in Jefferson City, Mo., was instantly killed a short time ago by a bursting emery wheel. His widow, Mary B. Schmidt, 1173 Jefferson street, Jefferson City, wishes to either sell the shop or secure the services of an expert machinist to conduct it.

Utilization of Gas From Suction Producers.*

BY DR. OSKAR NAGEL.

Producer gas power plants are built for generating, out of a suitable fuel, a mixture of carbon monoxide and hydrogen called "Dawson Gas," which, if used in gas engines, allows an exceedingly advantageous utilization of the fuel. Up to a few years ago producer gas has been made almost exclusively in so-called pressure gas producers by evaporating water in a separate boiler and by leading the steam, mixed with air, by means of a steam blower or fan, through the glowing fuel whereby the steam is decomposed to hydrogen and the coal burned to carbon monoxide. This mixture of combustible gases is led through a scrubbing arrangement for removing the dust and tar, then through a gas holder for equalizing the fluctuations of the pressure, and from here to the engine.

It is evident from this description that for generating gas by this method a boiler and a gas holder are required, which entails considerable cost of construction and attendance, and requires also a large floor space. Another disadvantage of the pressure of system is, that it cannot be installed inside the city limits, as it is not without danger on account of the possible leakage of gas. It was, therefore, an object of inventive engineers to supplant this pressure system by a safe and simpler construction in which no stock of gas is kept on hand, and in which no leakage can possibly occur. This has been fulfilled by means of the so-called suction gas producer, in which the pressure is supplanted by the suction of the moving gas engine. The use of a boiler and a gas holder is done away with in this system, as the engine is sucking just as much air and steam through the fuel as to generate the necessary amount of gas for the work required. This type has been very well developed on the Continent, and is especially to be recommended for units up to 250 horse-power.

In a suction gas producer plant the boiler is supplanted by an evaporator which, in small plants, is built frequently on the top of the producer in the form of a water-jacket, and in large plants close to the producer in the form of a tubular evaporator. This evaporator is generating the steam required by utilizing the waste heat of the producer and of the gas, which is of considerable advantage as compared to the old system, the firing of a separate boiler being dispensed with. The heat of the gases, respectively, of the producer, is entirely sufficient for furnishing the quantity of steam required for the generation of an effective power gas.

The utilization of fuel in suction gas producers is higher than in pressure producers, and is reaching 80 per cent. or more. The transformation of steam into hydrogen and the formation of carbon monoxide are taking place so quickly that the producer is always making the amount of gas required and is able to start suddenly from a low to a full load.

The advantages of a suction gas producer are: automatic generation of the gas by the engine; highest and best utilization of fuel; no boiler and no gas-holder are required; can be erected without danger in any convenient place; easy to start and to run; no soot, no smoke, no odor; no explosion possible; small floor space required.

A complete suction gas producer plant consists of a blower which up to 150 horse-power is driven by hand; a producer, an evaporator, an overflow water-pot, a scrubber, and a small equalizing tank. In plants above 75 horse-power a sawdust scrubber is advantageously inserted behind the wet scrubber, and in plants where two or more engines are fed from the same producer a small gas-holder with automatic regulation is used.

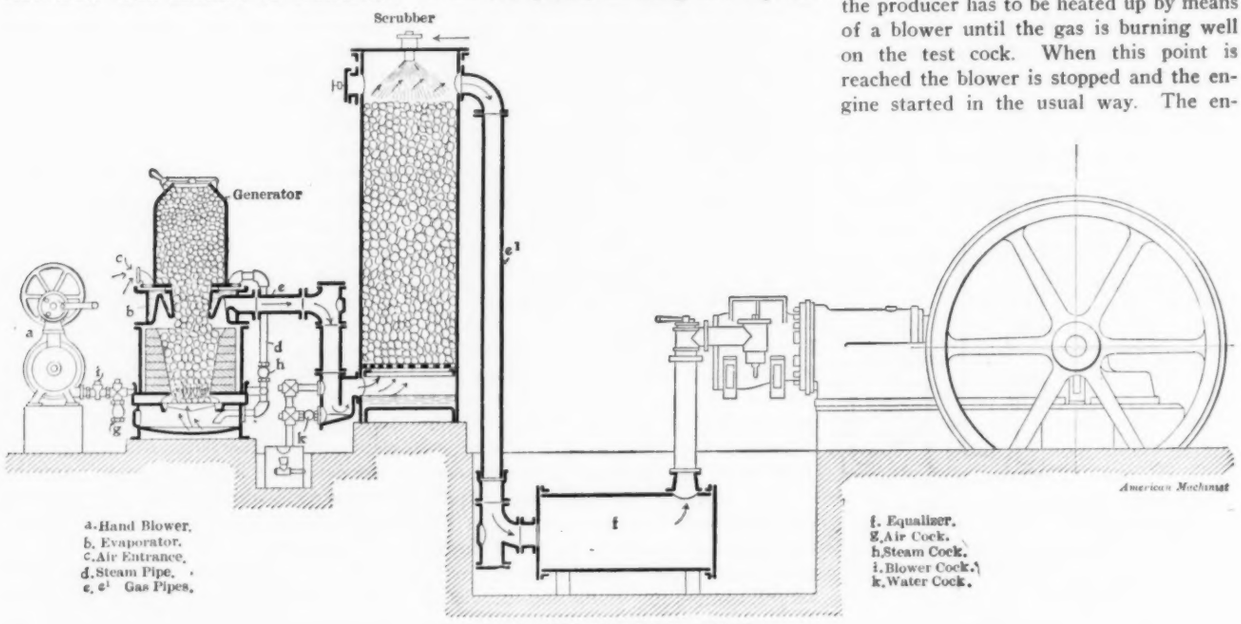
The producer consists of an iron shell lined with fire bricks and provided with a suitable hopper. The grate area, according to the quality of fuel, is 0.08 to 1 square foot for every 10 horse-power. The scrubber consists also of a sheet iron shell and is filled preferably with broken coke. If a good quality of fuel is used, the scrubber has to have a capacity of at least 1 cubic foot for every horse-power.

Before starting the engine the fuel in the producer has to be heated up by means of a blower until the gas is burning well on the test cock. When this point is reached the blower is stopped and the engine started in the usual way. The engine is now drawing by her own sucking action the necessary amount of air and steam through the fuel, and is producing her own power gas.

From the producer the gas is drawn through the scrubber and the equalizing tank to the engine. The gas-making process continues as long as the engine is moving, but as soon as the engine is stopped the gas making is also stopped.

Anthracite, charcoal or coke can be used equally as well for generating gas in a suction gas producer. It will take, according to the ash content, 1 to 1¼ pounds of anthracite or charcoal, or 1¼ to 1⅓ pounds of coke for developing 1 horse-power hour. With anthracite (pea) at $5 per ton, 1 horse-power hour will cost about one-quarter of a cent. This is about one-sixth the cost of illuminating gas power at a price of 75 cents per 1,000 cubic feet of gas, or one-eighth of the cost of gasoline power, figuring gasoline at 16 cents per gallon.

An ordinary illuminating gas engine has to undergo some slight changes be-



SUCTION GAS-PRODUCER PLANT.

*A paper read before the Society of Chemical Industry.

fore it can be used for producer gas. The compression has to be increased to at least 105 pounds and the ratio of gas to air has to be arranged 1 : 1¼. The gas inlet has to be increased, and the air inlet decreased to the ratio above named.

Comparative Test of Welds Made at the Government Arsenal at Toulon.

The accompanying table shows the result of a competitive test between a prominent welding compound and the Laffitte welding plate, giving the tensile strength and elongation before and after welding; the test was an official one made at the government arsenal at Toulon, France, principally with a view to ascertaining the value of the plates in welding and repairing steel castings, such as locomotive frames, locomotive driving wheels, etc.

COMPARATIVE TEST OF WELDS.

Material Used.	Tensile Strength.			Elongation.		
	Bar Before Welding.	Welded with Compound.	Welded with Laffitte Plate.	Bar Before Welding.	Welded with Compound.	Welded with Laffitte Plate.
	Lbs.	Lbs.	Lbs.	%	%	%
Iron upon iron..	48,700	44,729	48,938	16.33	9.66	14.33
Iron upon soft steel.....	48,700	43,964	45,631	16.33	4.00	4.00
Steel upon soft steel.....	75,935	72,197	80,500	2.00	1.00	2.00
Iron upon cast steel.....	95,935	43,719	48,692	2.00	3.25	9.05
Cast steel upon cast steel....	95 030	92,712	102,711	5.62	3.00	5.00

Meeting of National Railroad Blacksmiths' Association.

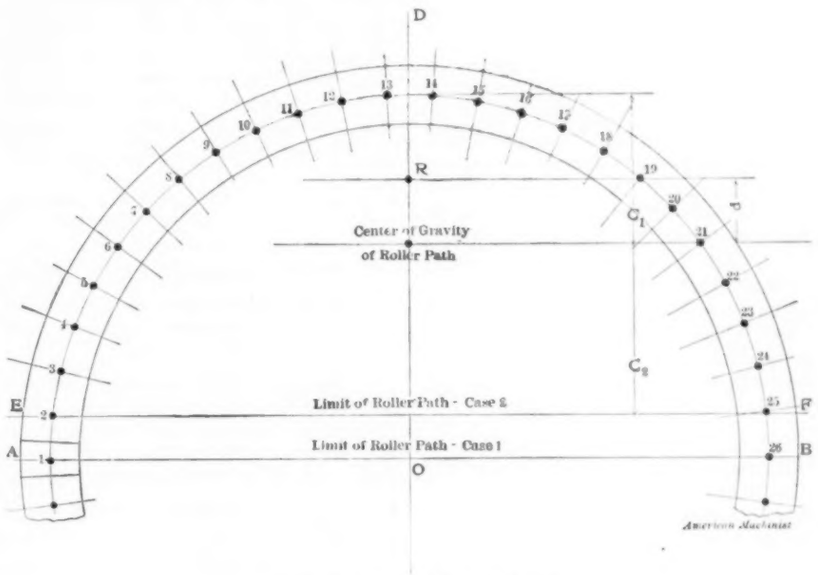
The National Railroad Master Blacksmiths' Association held their thirteenth annual convention in Cleveland, O., August 15, 16 and 17. There was a larger number in attendance than ever before in the history of the organization. The meeting was opened with prayer followed by an address of welcome by Mayor Tom L. Johnston, and the usual president's greeting by Thomas F. Keane. W. W. McLelland, of Denver, presented the association with $200. Chicago was chosen as the next meeting place, and the following officers were elected: President, David B. Swinton, of the Canadian Pacific Railroad, located at Montreal; first vice-president, John S. Sullivan, Pittsburg, Chicago & St. Louis Railroad, Columbus, O.; second vice-president, G. H. Judy, Baltimore & Ohio Railroad, Pittsburg, Pa.; chemist, G. H. Williams, B. M. Jones & Co., Boston; secretary and treasurer, A. L. Woodworth, Cincinnati, Hamilton & Dayton Railroad, Lima, O.

More than one-fourth of the whole foreign trade of the United Kingdom comes in and goes out of the port of Liverpool. Last year the trade increased 400,000 tons.

Calculation of Loads on the Rollers of a Large Locomotive Crane.

BY A. L. WESTCOTT.

The sketch shows a portion of the plan of the roller track of a 40-ton locomotive crane. The diameter is 20 feet. The center of pressure of the rotating platform, machinery and load is known, being indicated in the sketch by the point R. This load is carried entirely by the rollers, there being no center pin to act as a tie at the center, and the stability of the rotating parts depends entirely upon the position of their center of gravity inside the roller track. Under these conditions the entire load will be borne upon a certain number of rollers, located symmetrically about the center line $O\,D$, the maximum roller pressure being, of course, at D, and decreasing in amount under the successive rollers, until it becomes zero at some chord $E\,F$. The zone $E\,D\,F$, then, embraces all the rollers that are under pressure, and this portion of the roller track will be referred to as the roller path.



ARRANGEMENT OF CRANE ROLLERS.

Let c_2 = the distance from the line $E\,F$ to the center of gravity of the roller path.

c_1 = distance from rollers 13-14 to the center of gravity of roller path,

d = distance from the center of pressure of load to the center of gravity of roller path,

P = total load on rollers,

N = number of rollers under pressure,

M = mass of one roller,

I = moment of inertia of roller path about the gravity axis,

I_1 = moment of inertia of roller path about the diameter $A\,B$,

S_1 = maximum roller pressure,

S_2 = minimum roller pressure = 0.

Then

$$S_1 = \frac{P}{N} + \frac{P\,d\,c_1}{I} \qquad (1)$$

$$S_2 = \frac{P}{N} - \frac{P\,d\,c_2}{I} \qquad (2)$$

As $S_2 = 0$, we have from (2)

$$d = \frac{I}{N\,c_2}$$

Substitute this value of d in (1), and we have

$$S_1 = \frac{P}{N}\left(1 + \frac{c_1}{c_2}\right)$$

Let x = the distance to any roller from the gravity axis, and S = the load on that roller; then, in general, for any roller,

$$S = \frac{P}{N}\left(1 \pm \frac{x}{c_2}\right) \qquad (4)$$

the positive sign being used for rollers lying between D and the gravity axis, and the negative sign for those lying on the other side of that axis.

It remains to determine the extent of the roller path, its center of gravity and moment of inertia. The most practicable method is to assume the extent of the roller path tentatively, locate its center of gravity, compute its moment of inertia, and solve for d, from the equation

$$d = \frac{I}{N\,c_2}.$$

If this value of d agrees with the distance from our gravity axis to the known position of the center of pressure of the rotating load, then our assumption is correct; if not, then another assumption must be made.

For example, suppose the weight of the rotating parts plus the load equals 300 tons, and its known center of pressure is 96 inches from the center of the roller track. Suppose the number of rollers to be fifty, and assume that the entire load

is carried by the rollers numbered from 1 to 26 of the sketch.

In Table 1 the distances of the rollers from the center line of the track $A\,B$ are tabulated and squared. The distance from the center of the circle O to the center of gravity of the assumed roller path is readily found, by adding together the distances tabulated, and dividing this sum by the number of rollers tabulated, the result being found to be 73.3 inches.

The moment of inertia I_1 equals the summation of all the products $M\,y^2$ of the constant roller mass M and the varying distances y from $A\,B$.

Since we may assume any value for M, suppose M to equal unity, when I_1 becomes simply the sum of the squares of y tabulated in column 3, Table 1. This sum equals 179,874.

The moment of inertia I, above the gravity axis, is found from this by deducting the product, $26 \times 73.3^2 = 139{,}700$; here also the mass being considered equal to unity.

$$179{,}874 - 139{,}700 = 40{,}174.$$

$$d = \frac{I}{N c_2} = \frac{40177}{26 \times 73.3} = 21''.$$

$73.3'' + 21'' = 94.3''$ = the distance to the center of pressure under the assumed conditions, $+ .7''$ less than the actual distance of 96".

Second, try a roller path consisting of all rollers above line $E\,F$ of the sketch, 24 in number.

The center of gravity of these rollers is found readily from the table, the sum of their distances from the center being the same, but the number by which this sum is divided being 24 instead of 26, and the resulting distance being 79.45".

$$C_2 = 79.45'' - 15'' = 64.45''.$$

The moment of inertia about line $A\,B$ is the same as in the former case, since the two rollers 1 and 26 lie on the line, and therefore do not count. These distances being equal to zero, deduct the product, $24 \times 79.45^2 = 151495$.

$179874 - 151495 = 28379$ = moment of inertia about the gravity axis.

$$d = \frac{I}{N c_2} = \frac{28379}{24 \times 64.45} = 18.3$$

$$18.3 + 79.5 = 97.8''.$$

This result is 1.8" greater than the actual distance of 96", showing that the load on rollers 2 and 25 does not reduce to zero when the center of pressure is 96" from the center of the roller track.

For the purpose of computing the loads on the rollers, it will be practically correct, however, to assume, to start with, that the loads on numbers 2 and 24 are equal to zero. The roller loads may then be computed from formula (4):

$$\frac{P}{N} = \frac{600000}{24} = 25000 \text{ lbs.}$$

The various distances, x, may be found from Table I. In Table II the results of the computation are tabulated.

No. of Roller.	Distance from Diameter A B. y	y^2
1	0"	0"
2	15"	225"
3	29.84"	890"
4	44.2"	1953"
5	57.8"	3341"
6	70.5"	4970"
7	82.14"	6740"
8	92.4"	8538"
9	101.3"	10262"
10	108.6"	11794"
11	114.1"	13019"
12	117.8"	13877"
13	119.7"	14328"

TABLE I. ORDINATES OF ROLLERS AND THEIR SQUARES.

No. of Roller.	Distance from Center of gravity. x.	$1 \pm \frac{x}{c_2}$	S
2	— 64.45	0	0
3	— 49.6	.24	6,000
4	— 35.28	.45	11,300
5	— 21.65	.665	16,600
6	— 8.95	.86	21,500
7	+ 2.7	1.04	26,000
8	+ 12.95	1.20	30,000
9	+ 21.85	1.34	33,500
10	+ 29.15	1.45	36,250
11	+ 34.65	1.54	38,500
12	+ 38.4	1.60	40,000
13	+ 40.3	1.62	40,500
			300,150
			2
	Total roller loads		600,300

TABLE II. CALCULATION OF LOADS ON ROLLERS.

In the description of the Universal monitor lathe, made by the Dreses Machine Tool Company and published at page 202, we refer to this as a 13-inch lathe. It is really a 15-inch lathe. We do not know how the mistake in the figure occurred.

Personal.

Will the contributor who gives his address as 136 East 119th street, New York, send his name to the editor?

We have a request to find the present address of De Lancey Stafford, who was formerly connected with the Brown & Sharpe establishment.

Chas. Parsons, of Chicago, well known in the pneumatic tool business, is now associated with the Independent Pneumatic Tool Company, and will travel out of Chicago.

R. S. Cooper, former representative of the Rand Drill Company, at Pittsburg, is now manager of the New York office, at 170 Broadway, of the Independent Pneumatic Tool Company.

E. W. McKeen, for the past six years foreman of the drilling, turning and grinding department of the Morse Twist Drill & Machine Company, has resigned to accept a position with the Union Twist Drill Company, Athol, Mass.

L. E. Thomas, formerly of the United Engineering & Foundry Company, of Pittsburg, has accepted the management of the Birdsboro Steel Foundry & Machine Company, taking charge on August 1.

C. H. Greene, formerly of C. H. Greene & Co., of Syracuse, N. Y., manufacturers of the "Eureka" snap flasks and other foundry supplies, has associated himself with the S. Obermayer Company, of Chicago, as superintendent of that department—the manufacture of snap flasks, floor flasks, bench and floor rammers, etc.

Walter E. Harrington has severed his connection as vice-president and general manager of the New York-Philadelphia Company, to become associated with J. G. White & Co., of New York, as operating manager. Mr. Harrington has had an exceptionally broad experience, particularly in the operation of electric railway, lighting and gas properties. As operating manager of J. G. White & Co., Mr. Harrington will supervise all of the railway, electric lighting, gas and other properties operated by it, and will make his headquarters at the New York office of the company, 43 Exchange place.

Mr. R. C. Handloser sailed on the 19th of August with his wife and infant son, and will reside in Berlin, where he will be sales representative for Germany and Austria of the Niles-Bement-Pond Company. Mr. Handloser has just completed a three months' inspection and study trip of the various works of the company named, spending the major portion of the time in the Pratt & Whitney shops. He was formerly with Gustave Diechmann & Sohn, of Berlin, and was in charge of their Vienna office. For some time past he has been in charge of the New York office of Dilworth, Porter & Co., Ltd., of Pittsburg, Pa. For a month or six weeks Mr. Handloser will be at the Liége exposition, where the Pratt & Whitney Company have an important exhibit.

Obituary.

Andrew Fletcher, of W. & A. Fletcher Company, of Hoboken, died August 7 at his home in Bernardsville, N. J., aged seventy-seven years. His firm in 1861 built the celebrated steamboat *Mary Powell*, and also built the *Albany* and the *New York*, of the Albany Line, and other well-known boats.

Capt. Lyman Hall, president of the Georgia School of Technology, at Atlanta, died, August 17, in a sanitarium at Danville, N. Y. Capt. Hall was graduated from the West Point Military Academy in 1881. He had been connected with the School of Technology since 1888. His death was due to nervous prostration, brought on by overwork. He was forty-five years old.

Manufacturers.

J. M. Hanley, of Providence, R. I., will erect a $35,000 factory.

The B. F. Barnes & Co. plant, Rockford, Ill., is being doubled in size.

The Hart & Hegeman Company, Hartford, Conn., will erect a $50,000 factory.

Booth & Co., of Chicago, Ill., will erect a $150,000 plant in Minneapolis, Minn.

Frank Houst has begun an electric light and power building at Continental, O.

The Western Maryland Railroad Company proposes to erect large shops in Williamsport, Md.

The John Deere Plow Company, Omaha, Neb., will largely increase its plant. George Peek is manager.

Work will begin shortly on the new foundry building to be erected at Bainbridge, Ga., for D. H. Sutherland.

The Commonwealth Electric Company, Hyde Park, Chicago, Ill., will enlarge its plant at a cost of $150,000.

The Nordyke & Marmon Company, West Indianapolis, Ind., will build a new foundry building, to be 340x104 feet.

The Pressed Steel Car Company will erect a plant for the manufacture of steel cars at McKees Rocks, Pittsburg, Pa.

The Columbus Light Company has been organized at Columbia, Tex., to operate an electric light and power plant.

The Meriden (Conn.) Fire-Arms Company will erect a new factory, to be 350 feet long. Work is to begin next spring.

F. E. Myer & Brother, pump and hay tool manufacturers, Ashland, O., will erect an addition to the foundry of their plant.

M. W. Kellogg & Co., 35 Dey street, New York, will erect a factory in Jersey City, N. J., for the manufacture of mill supplies.

The Bay City (Mich.) Alkali Company, with a capital of $750,000, is to erect a 375x130-foot factory building in that city.

The Lockwood Manufacturing Company, South Norwalk, Conn., will erect a four-story building, in addition to its present plant.

The Johnson Boiler & Machine Company, Joplin, Mo., will enlarge its shops, and will also arrange for handling mining machinery.

The National Bed Company, Moundville, W. Va., will erect a large plant at Glendale, W. Va. Contracts have not yet been awarded.

It is said that Thomas A. Edison will at once begin the erection of a factory for the manufacture of his recently perfected storage battery.

It is reported that the Central Foundry Company, Baltimore, Md., is arranging for the erection of a pattern shop at its plant at Dundalk, Md.

A foundry and car manufacturing plant is to be established at Beaumont, Tex. Secretary Spaulding, of the Chamber of Commerce, can give information.

The plant of the Bartlett Steel Company, Joplin, Mo., has been destroyed by fire, at a loss of $50,000. President Wingert announces that the company will rebuild.

The planing mill and sheds which were recently destroyed by fire at Gifford, Ark., will be rebuilt by the owner, the Stewart & Alexander Company, at a cost of $35,000.

It is understood that work will be commenced at once on the Prudden factory on Sheridan street, Lansing, Mich., which has been in contemplation for some time.

The factory of the Wisconsin Veneer Company, Rhinelander, Wis., recently destroyed by fire, will be rebuilt immediately, on a much larger plan, with greatly increased facilities.

J. B. Adger, Charleston, S. C., is interested in the erection of a $300,000 power plant at Hollidays, S. C. Power from this plant will be distributed to cotton mills in the vicinity.

A company will be organized in the near future by W. R. Odell, of Concord, N. C., and others, with a capital of $500,000, to establish a mill at Nashville, Tenn., for the manufacture of bag cloth and sheetings.

The contract has been let for the rebuilding of the Elizabeth Iron Works, Norfolk, Va., which were recently destroyed by fire. They will be rebuilt on the old location on Water street, at a cost of $80,000.

The North Birmingham Forge Company, Birmingham, Ala., incorporated to operate a forge and foundry. Plant has been purchased and will be in operation in the near future. J. H. Minge, Jr., is president.

Work is now progressing on the new addition to Peck, Stow & Wilcox Company's plant, East Berlin, Conn., and will be pushed to completion as early as possible. New machinery has been ordered for this extension.

Ballington & Perrot, architects have invited estimates for a manufacturing plant, consisting of a machine shop, foundry, pattern and pattern storage shop and boiler-house, at Elkins, W. Va., for the Humphrey Manufacturing Company.

Joseph Honhorst will build a two-story brick and concrete factory building at 1016 and 1018 Sixth street, between Carr and Freeman avenue, Cincinnati, O. The building will be used as a plant for the manufacture of sheet metal articles.

Work is shortly to be commenced by Grise Brothers on the construction of a manufacturing plant at Hastings, Neb., for the manufacture of windmills. There will be two brick buildings, 78x100 and 36x80. The plant is to be completed by October.

The Alma Manufacturing Company, at 611 to 627 South Monroe street, Baltimore, Md., is preparing to erect three additional buildings to its plant. Some time ago the company purchased a large lot adjoining the plant, which it was announced would be used for additional buildings.

The Berwind-White Coal Mining Company, whose large bituminous plant at Jersey City, N. J., supplies fuel to various corporations, has closed an option on fifty acres of land near Hollidayburg, Pa., on which will be built a plant for constructing and repairing steel cars used by the company.

It is reported that the Milford Construction Company (Wallace C. Johnson, Niagara Falls, chief engineer) has closed a contract with James B. Mullen, of Bangor, Me., for the construction of its dam and power-house. The plant consists of a concrete dam across the Penobscot River, at Oldtown, Me.

The American Arc Lamp Company, formerly the Lea Electric Company, now located at Elwood, Ind., will soon be added to Kalamazoo's factory list. C. A. Dewing and W. S. Dewing, of that city, now own the controlling stock in the company and are instrumental in bringing it to Kalamazoo. They are building.

A new power-house, 100 feet square, is being completed by the Erie Railroad at Hornellsville, N. Y. New machinery has arrived on the ground and is being installed. As it will be necessary to move nearly all the machinery in the plant to conform to the new plan, it will be necessary to erect a new traveling crane.

The Scully Steel & Iron Company, Chicago, Ill., has in view the construction of a large steel warehouse at the southeast corner of Carroll avenue and Elizabeth street. George Birkhoff, Jr., has just conveyed to the corporation a tract of land at that place, 331x141 feet, for the nominal consideration of $5. The land cost $45,000.

Esenwein & Johnson have completed plans for an extension to the American Brake Shoe & Foundry Company's shop at No. 1674 Bailey avenue, Buffalo, N. Y., to cost between $15,000 and $16,000. Plans have also been made for an extension to the works of the General Railway Signal Company, on Elmwood avenue, Buffalo, to cost $30,000.

The Reder Foundry Company, Chicago, Ill., will erect a complete plant at the southwest corner of Canalport avenue and Johnson street, after plans by Joseph T. Fortin. The buildings will be a three-story pattern shop, 103x76 feet; a one-story foundry, 90x90 feet, and several sheds; the main buildings to be of stone, brick and steel. The cost is estimated at about $50,000.

Appleton & Burrell, Philadelphia, Pa., have been awarded the contract for the erection of additions to the plant of the Bernstein Manufacturing Company, at Third and Westmoreland streets, Philadelphia, designed by Architects and Engineers Ballinger & Perrot, to cost $20,000. The additions will include a one-story foundry building, 200x50 feet; a rumbler and cupola room, 47x48 feet, and a core oven, 45x21 feet. All of the structures will be 30 feet high, of brick, with slag roofs, containing lanterns.

The defunct Lancaster Malleable Iron Works, bought by the American Brake Shoe & Foundry Company, is to be remodeled and fully equipped as a first-class malleable casting plant. Officers of the American Brake Shoe Company are now organizing a company to operate this plant, which will be incorporated under the laws of New Jersey and known as the American Malleable Iron Company. This latter plant will be worked in conjunction with the Brake Shoe Company's large malleable plant at Bloomfield, N. J., and all will be practically under the same management.

New Catalogues.

Gleason Works, Rochester, N. Y. Gear list and tables. Oddly and handsomely printed. 6x9.

Ingersoll-Sergeant Drill Company, 11 Broadway, New York. Rock-drill leaflet, Form 43A. Illustrated.

The Ingersoll-Sergeant Drill Company, 11 Broadway, New York. Booklet descriptive of the "Radialax" coal cutter. Illustrated.

Commercial Electric Company, Indianapolis, Ind. Circular No. 200. Induction motors for constant speeds. 6x9, pp. 7. Illustrated.

The Richmond Electric Company, Richmond, Va. Bulletin No. 6, descriptive of new types of R. E. induction motors. Illustrated.

D. Round & Son, Cleveland, O. Catalogue No. 36, "Hoisting Machinery for Easy Lifting by Hand-Power." 5x7, pp. 48. Illustrated.

The Cleveland Twist Drill Company, Cleveland, O. Catalogue illustrating tools for turret lathes and screw machines. Pp. 16. Illustrated.

Kilgore-Peteler Company, Minneapolis, Minn. Catalogue No. 3, descriptive of various types of dump-cars manufactured by this company.

Brown Specialty Machinery Company, Chicago, Ill. Booklet descriptive of the various specialties of this company. 9x4, pp. 9. Illustrated.

The Cincinnati Time Recorder Company, Cincinnati, O. Catalogue descriptive of the time-recording supplies of this company. 6x9, pp. 16. Illustrated.

The Automatic Clutch Company, Akron, O. Booklet C, "Clutchology," descriptive of the clutch manufactured by this company. 3½x6¼, pp. 16. Illustrated.

The Emerson Electric Manufacturing Company, St. Louis, Mo. Bulletins No. 3105 and 3952, dealing with single-phase induction motors and miscellaneous pulleys. Illustrated.

The Cleveland Twist Drill Company, Cleveland, O. Catalogue descriptive of tools in sets, designed for turret lathes and screw machines. 6x9, pp. 16. Illustrated.

Wilcox Manufacturing Company, Aurora, Ill. Catalogue No. 6, descriptive of various types of door-hangers and hardware specialties. Handsomely printed and illustrated. 6x9, pp. 156.

Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. Bulletins Nos. 145 and 460, descriptive of varying types of motors as applied to small tools, fans, etc. 6x9. Illustrated.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 50 (superseding spherical machine sections of Bulletins 30 and 35), descriptive of various types of motors. 7x10, pp. 24. Illustrated.

Crane Company, Chicago. "Advance Treatise No. 7-FJ." A brief treatise concerning the merits of the various styles of joints used in attaching flanges to wrought pipe. Illustrated.

The Lane & Bodley Company, Cincinnati, O. Catalogue descriptive of heavy-duty and Columbian Corliss engines. 6x9, pp. 26. Illustrated. Also Form 29, booklet descriptive of "New Design Slide-Valve Engines," and Form 161, "Hangers."

General Electric Company, Schenectady, N. Y. Bulletins No. 4414, 4415, 4416, descriptive of electrically driven turbine house pumps, Thomson recording wattmeters—Type "C," and service cut-outs. Illustrated. Also flyer leaflets Nos. 2159 to 2163, fuse cut-outs and electric lighting appliances.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

I design factories and special machines. James F. Hobart, 66 70th st., Brooklyn, N. Y.

Wanted—A second-hand, open-side planer to plane about 8 ft. long. F. Kittens Machine Works, Ferdinand, Ind.

Two steam turbine experts wish to interest a good machine concern or capitalists for a design of their own. Box 477, AM. MACH.

Wanted—Information concerning manufacturers of vacuum pans for evaporation of liquids. Sligo Furnace Co., Sligo, Dent Co., Mo.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—One new or second-hand 36"x36"x 8' planer with 2 heads on cross-rail, or 1 head on cross-rail and 1 head on side-rail. Address Green Engineering Co., Western Union Bldg., Chicago, Ill., giving full description and price.

For Sale.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

The complete course in civil engineering, including about 12 bound volumes, as given by the International Correspondence Schools of Scranton, Pa. "Education," care AM. MACH.

For Sale—At a bargain, drawings, patterns and special tools for line machine tools; also large quantity finished and partly finished parts of machines. Address "Receiver," care AMERICAN MACHINIST.

For Sale—An up-to-date manufacturing shop, located in Manhattan, New York city, suitable for inventor, general machine, experimental work or manufacturing; first-class machinery; electric power; large assortment fine tools; foreign and domestic trade; patents, stock, good will, or plant alone; reasonable. Address Box 442, AMER. MACHINIST.

Business Opportunities.

Machinists who can take financial interest in shop write to Box 446, AMER. MACH.

Machine Shop for Sale.—Here is a great opportunity for someone who wants a business of his own. This is a modern plant, located in central New York. Main building, 100x60 ft., two stories, equipped with about 60 high-grade machine tools, including lathes, milling machines, shapers, drills, etc. Plant is adapted for automobile or any high-grade work, and is now running. This plant and business cost more than $50,000, and we can sell it for less than $15,000, if taken promptly. This price includes patents, jigs and tools for making a very profitable specialty. To the right parties we can make very favorable terms. Wm. A. Reade & Co., 402 Chamber of Commerce, Cleveland, Ohio.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Position as assistant mechanical draftsman, by young man; 3 years' experience. Box 504, AMERICAN MACHINIST.

Draftsman and designer, well up in theory and with long experience in shop and drafting room, is open for engagement. Box 500, AMERICAN MACHINIST.

A thorough, all-round mechanic; 20 years' experience on experimental and model work, designing and getting up modern tools, dies, fixtures, patterns, special and automatic machines; 8 years' experience in supervising toolrooms, manufacturing and assembling departments. Box 488, AMERICAN MACHINIST.

ILLINOIS.

Situation Wanted—Superintendent; practical mechanic, with 15 years' experience in machine shops. Address Box 501, AM. M.

NEW JERSEY.

Draftsman; technical, practical; well acquainted with tools, jigs and fixtures; 10 years' shop and drawing experience and 4 years as shop foreman; also well acquainted with electricity. Box 512, AMER. MACH.

Young man, competent as manager's secretary, office manager and purchaser of mill supplies, etc., wishes to change location; several years' experience as above along mechanical, metallurgical and electro-chemical lines, with best recommendations. Address Box 489, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 505, AMERICAN MACHINIST.

Machinist, 22, excellent references, desires position. Box 491, AMERICAN MACHINIST.

Mechanical draftsman, 25, experienced on automobile machinery, wants position. Box 506, AMERICAN MACHINIST.

Mechanical engineer, age 26, pupil of Prof. Riedler, graduate Berlin University, Germany, desires position; best references. Box 503, AMERICAN MACHINIST.

Foundry foreman, first-class man, 42 years old, wide experience on a large variety of work, desires position. Address "42," care AMERICAN MACHINIST.

Mechanical draftsman, 3½ years' experience, would like position in engineer's office or as draftsman in manufacturing concern. Box 502, AMERICAN MACHINIST.

Technical graduate desires odd jobs at drafting or contracting; has had 8 years' experience in the building, mechanical and electrical line. Box 490, AMERICAN MACHINIST.

Mechanical engineer, 34, practical toolmaker, with 9 years' experience as chief draftsman and assistant superintendent of large works, wants superintendency smaller plant. Box 411, AM. M.

Works manager; machine-tool lines preferred; age 30; experience practical, engineering and business; 10 years of successful work to show; have a good job; want a better one and a chance for a proprietary interest; salary $2,500. Address Box 492, AM. MACH.

Position chief engineer or master mechanic; thoroughly understand engines, boilers, dynamos, motors, manufacturing machinery, etc.; good executive ability; assume full responsibility; first-class mechanical engineer; first-class references. Address Box 493, AM. M.

OHIO.

Strictly high-grade, brainy mechanic desires executive position, perfecting or manufacturing products. Box 441, AMER. MACH.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

Mechanical engineer and expert designer, with long and varied experience, Corliss engines, power transmission, gas engines, is open for engagement; competent to take charge, and accustomed to the control of men. Box 485, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical engineer, general work, wants position as chief draftsman or assistant superintendent. Box 495, AMER. MACHINIST.

Mechanical engineer wants position; has over 20 years' experience designing gas and gasoline engines; expert at tool and jig designing to cheapen manufacturing; specialty, marine engines; has design for simple self-starting and reversing four-cycle marine engine. Address Box 494, AMER. MACHINIST.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 507, AMERICAN MACHINIST.

VERMONT.

Mechanical draftsman wants engagement; 12 years' practical experience on hydraulic machinery, gate valves, pumps, special machinery for gas, water, steam, etc. "Hydraulic," care AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Machinists upon lathes and grinders. Address Bantam Anti-Friction Co., Bantam, Conn.

ILLINOIS.

Wanted—An experienced, energetic and competent factory superintendent, trained to fine work, who will become financially interested in the company; this is an unusual opportunity, as the company is young, thoroughly equipped, and has an assured future. America Co., Rockford, Ill.

Wanted—Expert drop forge die and tool designer on medium work, by large manufacturing concern; must be thoroughly posted on modern shop methods, with ability to handle men; in answering, state full particulars; no applicant will be considered whose record does not prove him to be of the highest grade. Box 463, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MARYLAND.

Machine tool traveling salesman of experience wanted; must be well posted on metal planing and drilling machinery; salary and commission given. Address "Planer," care AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—First-class toolmaker; state experience, wages expected. Box 460, AM. M.

Wanted—Operator for Cleveland automatic screw machines. Address Boston Gear Works, Boston, Mass.

Wanted—Assistant superintendent, experienced in gear-cutting job shop. Address, with full particulars, Boston Gear Works, Boston, Mass.

One draftsman, one planer hand, two machinists of first class and accustomed to finest machinery; state experience; reference is required. Box 471, AMERICAN MACHINIST.

Wanted—First-class machinists for Jones

& Lamson turrets, planers, drills, vise work, floor work; steady work; good wages. Apply to Campbell Printing Press & Mfg. Co., Taunton, Mass.

Wanted—A young man with a technical education (Mass. Ins. Technology preferred), who understands principle, and with a practical knowledge of gas engines; shop located in eastern Massachusetts; send references and further information; a good opening for a young, ambitious man. Box 472, AM. MACH.

NEW JERSEY.

Wanted—Draftsmen with experience on wire covering machinery; reply, stating experience and pay expected. Box 466, AM. M.

Wanted—Machinists familiar with vise work and erecting stationary engines and air compressors; give age, experience and previous employment. Address Box 458, AM. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

A good mechanic, used to manufacturing brass novelties or jewelry, can buy into a firm who have an established business and new contracts on hand insuring a large volume of business for the balance of the year; new contracts call for additional capital and the assistance of an expert mnufacturer. Address Box 508, AMERICAN MACHINIST.

First-class draftsmen, erectors, boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

NEW YORK.

Wanted—Five first-class tool and die makers for high-grade machine work; good wages and steady work to the right men. Apply to the Lisk Mfg. Co., Ltd., Canandaigua, N. Y.

Wanted—A first-class opportunity is open for a salesman who knows steel and its users, tempering liquids and oil for Novo steel, welding compound and slush oil. Box 470, AMERICAN MACHINIST.

Assistant foreman for tool-making department making punches and dies, jigs, fixtures, special tools and metal patterns; must be able to get first-class work out of his men. Address Box 509, AMERICAN MACHINIST. Give outline of experience and state age and present salary. Replies considered confidential.

OHIO.

Wanted—Foundry foreman, capable of running 50 men. Box 496, AMER. MACHINIST.

Wanted—A man of experience and ability in the manufacture of portable well-drilling machinery or similar work; give age, experience, reference and salary expected. Box 467, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—First-class designing draftsman; must have experience in air compressor or engine work; give age, experience and salary expected. Address Box 469, AMER. MACH.

Wanted—Electrical designer; one thoroughly familiar with the practical design of controllers and rheostats; state experience and salary. Box 497, AMERICAN MACHINIST.

Wanted—Mechanical engineer, experienced in design and manufacture of steam appliances; state age, education and experience in detail; good chance for the right man. Box 510, AMERICAN MACHINIST.

Wanted—At once, a number of first-class machinists, experienced in machine and floor work on engines; good wages and steady employment to first-class men. Jacobson Machine Mfg. Co., Warren, Pa.

Wanted—Competent designer and draftsman, who will be required to specialize on redesigning steam pumps; permanent position and splendid opportunity for advancement for the right man. Box 498, AMER. MACHINIST.

Wanted—Machinists; the Gisholt Machine Company invites application from machine hands, vise hands and erectors for its plant at Warren, Pa.; state class of work experienced on, whether married or single, age and wages expected. Address Gisholt Machine Company, Employment Department, Madison, Wis.

RHODE ISLAND.

Wanted—Foreman for machine repair shop, worsted mill; must be able to get best results possible from help (15 to 20 men); should be familiar with textile machinery; position permanent to the right man. Address Box 499, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—Six good gas engine engineers, familiar with operating large engine plants; good salary to right men; give experience and reference. Box 426, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Mechanics to design and construct parts for automobiles; competent men can have steady positions, with prospects for advancement. Address Thomas B. Jeffery & Co., Kenosha, Wis.

Wanted—First-class, practical, experienced mechanical draftsman and designer, familiar with publishers' automatic machinery; good salary and permanent position to competent and reliable man; references required; strictly confidential. Box 511, AMER. MACHINIST.

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See Roller Bearings.

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Greaves, Klusman & Co., Cin., O.
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Shultz Belting Co., St. Louis, Mo.

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Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

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Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
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Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.

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Wallace Supply Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Struthers-Wells Co., Warren, Pa.
Wickes Bros., New York.

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Acme Mchry. Co., Cleveland, O.
Brown Co., H. B., Easthampton, Conn.
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Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
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Wiley & Russell Mfg. Co., Greenfield, Mass.

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Hill Pub. Co., New York.
Wiley & Sons, Jno., New York.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.

Boring and Drilling Machines, Horizontal—*Cont'd*
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
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Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Athol Machine Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel
Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Catalogue Makers
Binner-Wells Co., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

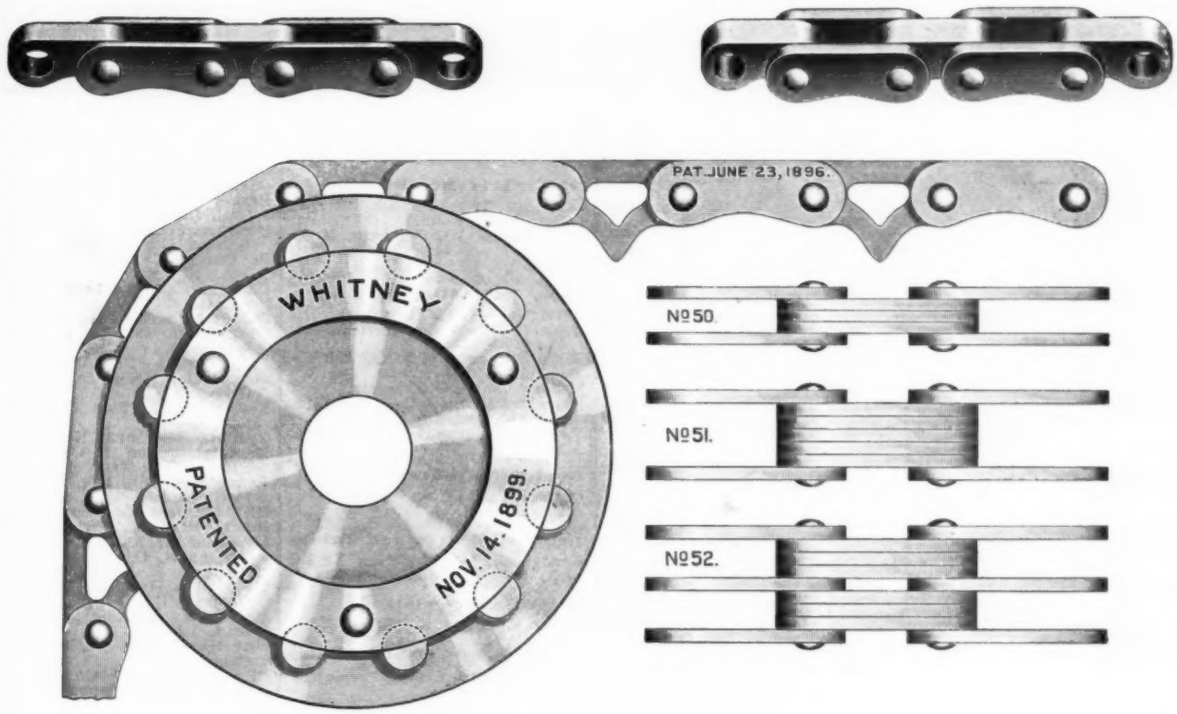
Centering Machines
Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.,
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.



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Gisholt Mach. Co., Madison, Wis.
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Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
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Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Circuit Breakers
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Coburn Trolley Track Co., Holyoke, Mass.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Bolt
Brown Co., H. B., Easthampton, Conn.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Huribut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.
Steel Set Diamond Co., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

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Bickford Drill & Tool Co., Cincinnati, O.
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McCabe, J. J., New York.
Morton Machine Tool Wks., Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
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Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

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Dreses Mach. Tool Co., Cin., O.
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Fosdick Mach. Tool Co., Cin., O.
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Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.

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Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
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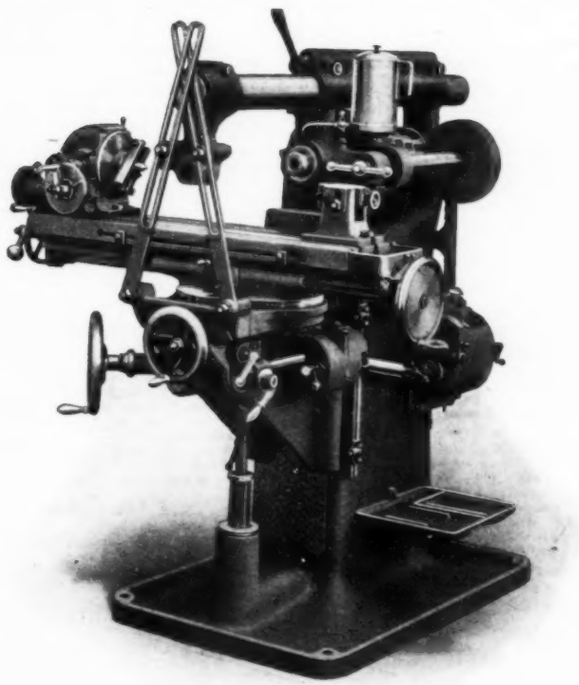

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Messmer Mfg. Co., Ferd., St. Louis, Mo.
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Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear. Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

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Albro-Clem Elevator Co., Philadelphia, Pa.
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Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
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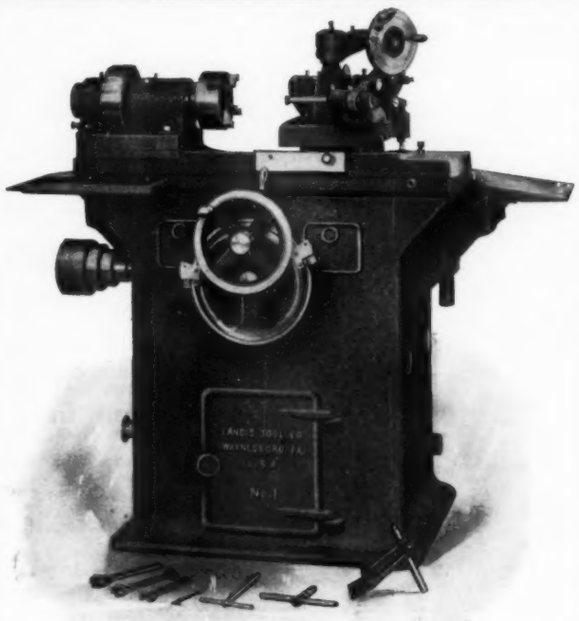
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.



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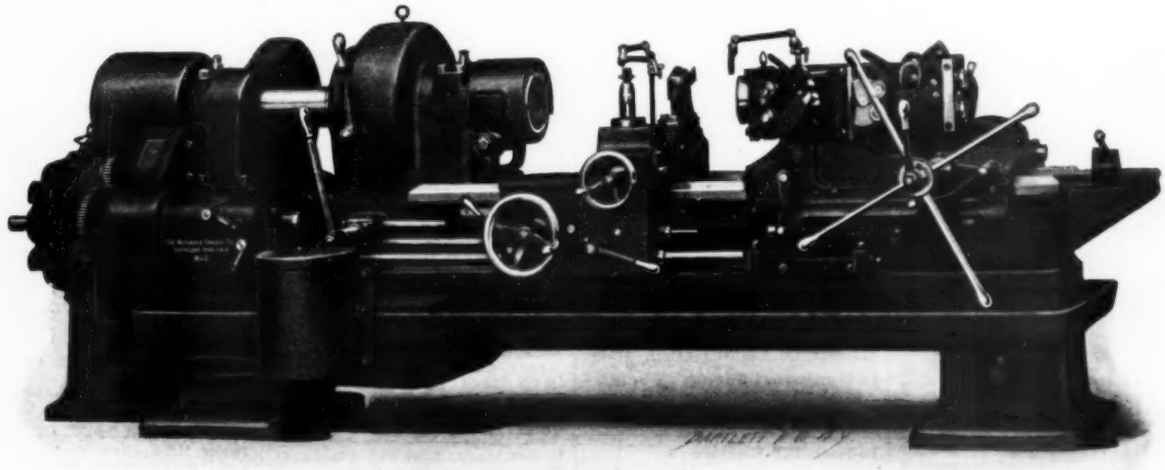

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International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Power
Niles-Bement-Pond Co., New York.
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Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
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Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.

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Curtis & Co. Mfg. Co., St. Louis, Mo.
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Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

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International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
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International Steam Pump Co., New York.
tour Falls, N. Y.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Street Bros. Machine Co., Chattanooga, Tenn.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Lathes—*Continued*
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Silk Mach. Tool Co., P. P., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Bancroft, Sidney, New York.
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

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Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
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McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
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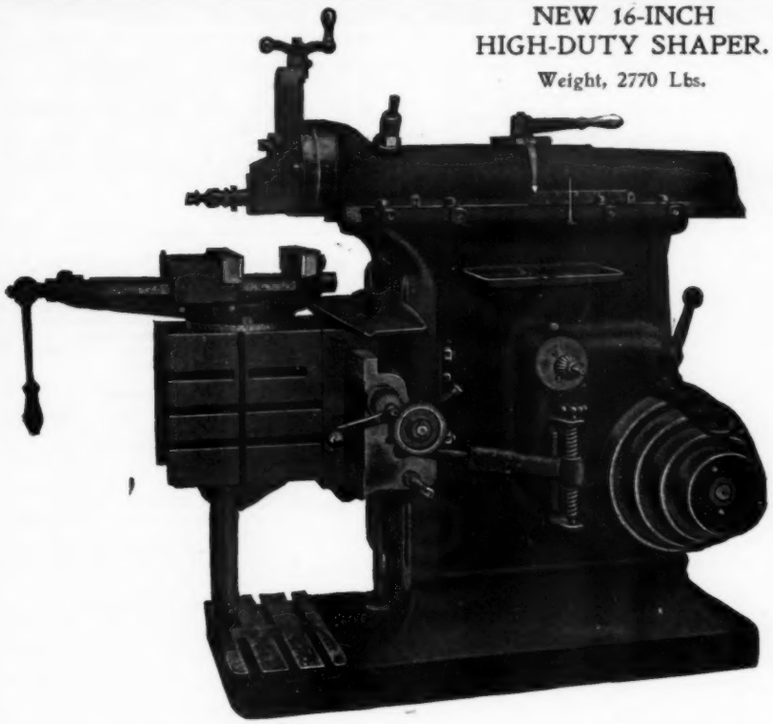

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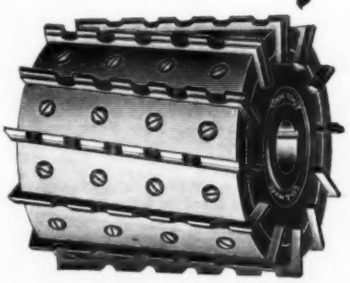

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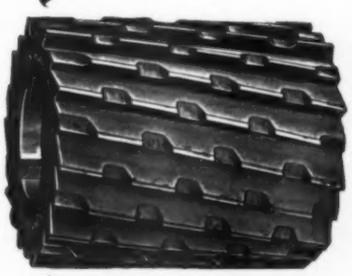

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Cutler-Hammer Clutch Co., Milwaukee, Wis.

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Nicholson & Co., W. H., Wilkesbarre, Pa.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Standard Tool Co., Cleveland, O.

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Phosphor Bronze Smelting Co., Philadelphia, Pa.

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Slocomb Co., J. T., Providence, R. I.
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Faneuil Watch Tool Co., Boston, Mass.
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Hill, Clarke & Co., Boston, Mass.
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Whitney Mfg. Co., Hartford, Ct.

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Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
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Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
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Le Blond Mach. Tool Co., R. K., Cincinnati, O.
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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
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Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Milling Machines, Vertical
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Beaman & Smith Co., Prov., R. I.
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
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Sprague Electric Co., New York.
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Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Bates Machine Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

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Besly & Co., Chas. H., Chicago, Ill.

Oils
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Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam
Houghton & Co., E. F., Philadelphia, Pa.
Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic
Houghton & Co., E. F., Philadelphia, Pa.
Watson-Stillman Co., New York.

Paints and Enamels, Machinery
Felton Sibley & Co., Phila., Pa.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

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Blount Co., J. G., Everett, Mass.
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Wiley & Russel Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools
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Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

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Ridgway Mach. Tool Co., Ridgway, Pa.
Sellers & Co., Wm., Phila., Pa.
Silk Mach. Tool Co., P. P., Cincinnati, O.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Newton Mach. Tool Wks., Philadelphia, Pa.
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Underwood & Co., H. B., Philadelphia, Pa.

Precision Machinery
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Drop
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Forging
Chambersburg Engineering Co., Chambersburg, Pa.

Presses, Hand
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Presses, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson-Stillman Co., New York.

Presses, Power
American Tube & Stamping Co., Bridgeport, Conn.
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
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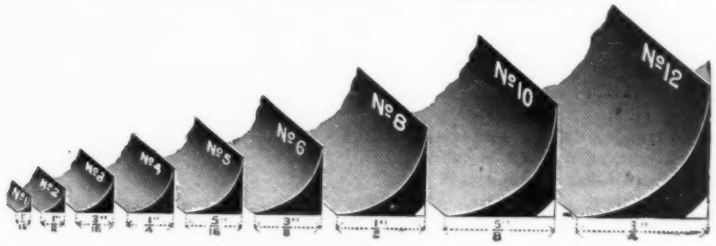

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Watson-Stillman Co., New York.

Punches, Power
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
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Hilles & Jones Co., Wilmington, Del.
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Niles-Bement-Pond Co., New York.
Royersford Fdry. & Machine Co., Royersford, Pa.
Vandyck Churchill Co., New York.

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Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

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Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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New Britain Mch. Co., New Britain, Conn.

Radiators, Japanning Oven
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Boker & Co., Hermann, New York.
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Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Lapointe Mach. Tool Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

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Chambersburg Engineering Co., Chambersburg, Pa.
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Watson-Stillman Co., New York.

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Dallett Co., Thos. H., Phila., Pa.
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Ingersoll-Sergeant Drill Co., New York.
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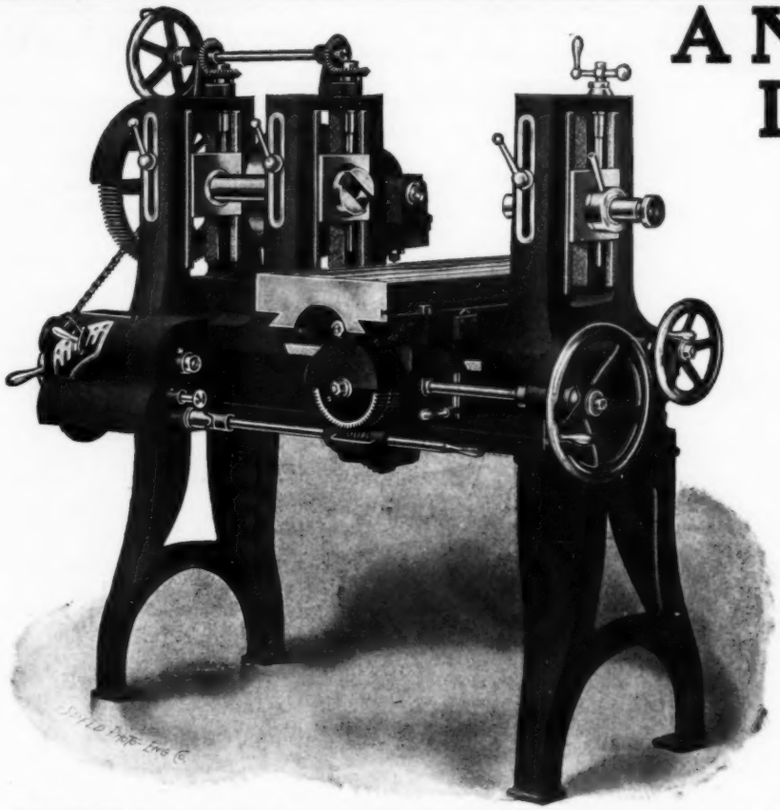

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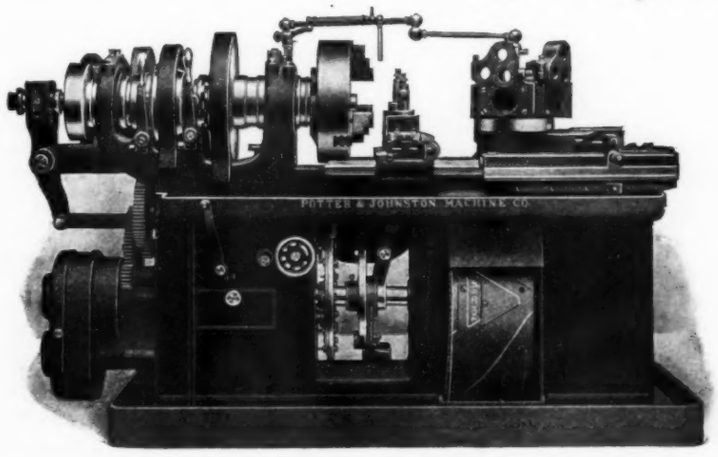

and the work is so conveniently and easily done that it is a pleasure to use it. It is for the finishing of castings of iron, steel or bronze up to 14 in. diam. by 7 in. long or work from the solid bar. All the operator has to do is to keep the machine supplied with work, the machine does the rest. One man can keep from 4 to 8 machines at work.

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The New Works of the Ingersoll-Sergeant Drill Company at Phillipsburg, New Jersey—IV.

It is hoped and believed that our readers appreciate these chimney-top pictures. They suggest some valuable and important uses of the camera which are not generally availed of. We are too much in the habit of expecting photographs to be taken with the camera in a perfectly horizontal position, and of regarding as unnatural or distorted all pictures taken from oblique or inverted positions. As the camera is assumed to reproduce what the eye can see, it can only do so by being permitted to look at the object at precisely the same angle as the eye itself will look, and as there is no limit to the angle at which our eyes may be employed, the user of the camera should have equal liberty.

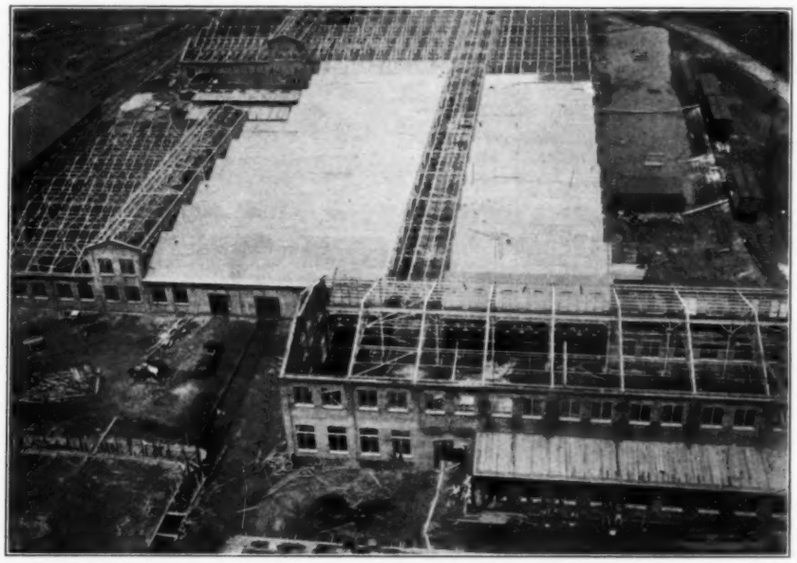


FIG. 46. CHIMNEY-TOP VIEW OF DRILL SHOP.

The chimney-top picture here shown, Fig. 46, possibly the last of them, taken while the drill shop was in process of erection, gives us perhaps a better idea of the general arrangement than could easily be had in any other way. There are quite a number of things brought to our notice in this picture. At the left we see a bit of the north end of the storage and shipping department, the other end of which runs into, and its track out through, the compressor erecting shop, as previously shown. The interior of this is seen in Fig. 49.

In the foreground of Fig. 46 we see the subway in process of construction. This subway was carried off to the left, as shown, before it was extended to the drill shop, because this left branch led to the foundry, which was ready and in operation some months before the other shops. The building in the right foreground is the stock or raw material warehouse. Its side abuts against the drill shop, and where their roofs unite there is no partition wall inside between them.

The drill shop, as a whole, is a fine example of the use of the saw-tooth roof in shop construction. The two monitors running transversely of the "saw-teeth" prove to be a valuable feature of the design, greatly promoting the circulation of the air within and rendering the shops at all times comfortable for the workmen. The entire area of the drill shop, as shown by the plan, Fig. 48, is $475 \times 260 = 123{,}500$ square feet, from which is to be deducted the space H, $125 \times 100 = 12{,}500$ square feet at the middle of the west side, which leaves the enclosed area 111,000 square feet, or a little over two and a half acres. The cutting into the side of the vast area, and the placing of the doorways for the workmen in the wall at L, brings them right into the middle of the shop. Inside the shop, and immediately in front of the wall L, there is a wide, open passage, running the entire length of the shop, and from this there is free communication to every part of the interior. The space H is not unoccupied, having coatrooms and lavatories on each side, as seen in Fig. 47. Time clocks are placed inside the doors, with railings in front to keep the men in line. The drill shop office is in the middle of the shop, lengthwise and against the east wall, with the toolroom in front of it, or in the most central position possible.

FIG. 47. NORTHWEST CORNER OF DRILL SHOP.

Some idea of the total equipment of machine tools in this shop may be formed from the figures which follow. There are in all, 92 lathes of various styles and sizes, and it is probably quite safe to say that for the present output of the shop, if operated at the gait and according to the methods of a quarter of a century ago, at least ten times this number of lathes would have been required, with, of course, a man to each. Of the various tools of the shop, the lathes are now more frequently standing idle than any others. There are 31 "automatic" machines, and 42 turret lathes and screw machines, these all doing, of course, the work of the old-time lathe hand. There are only 5 planers in the shop, but there are 63 millers, which tells the story of the change which has come over the lines of work for which these machines are responsible.

While the drive of the shop is of course entirely electric, there are comparatively few of the tools which are individually motor driven. These are chiefly the planers and the cutting-off machines. There is a line shaft with its motor in each bay and from these shafts the machines are driven by belting in the usual way. The machines of each class are located together, as may be seen in the magnificent shop interiors here reproduced. In Fig. 50 there are turret lathes as far as

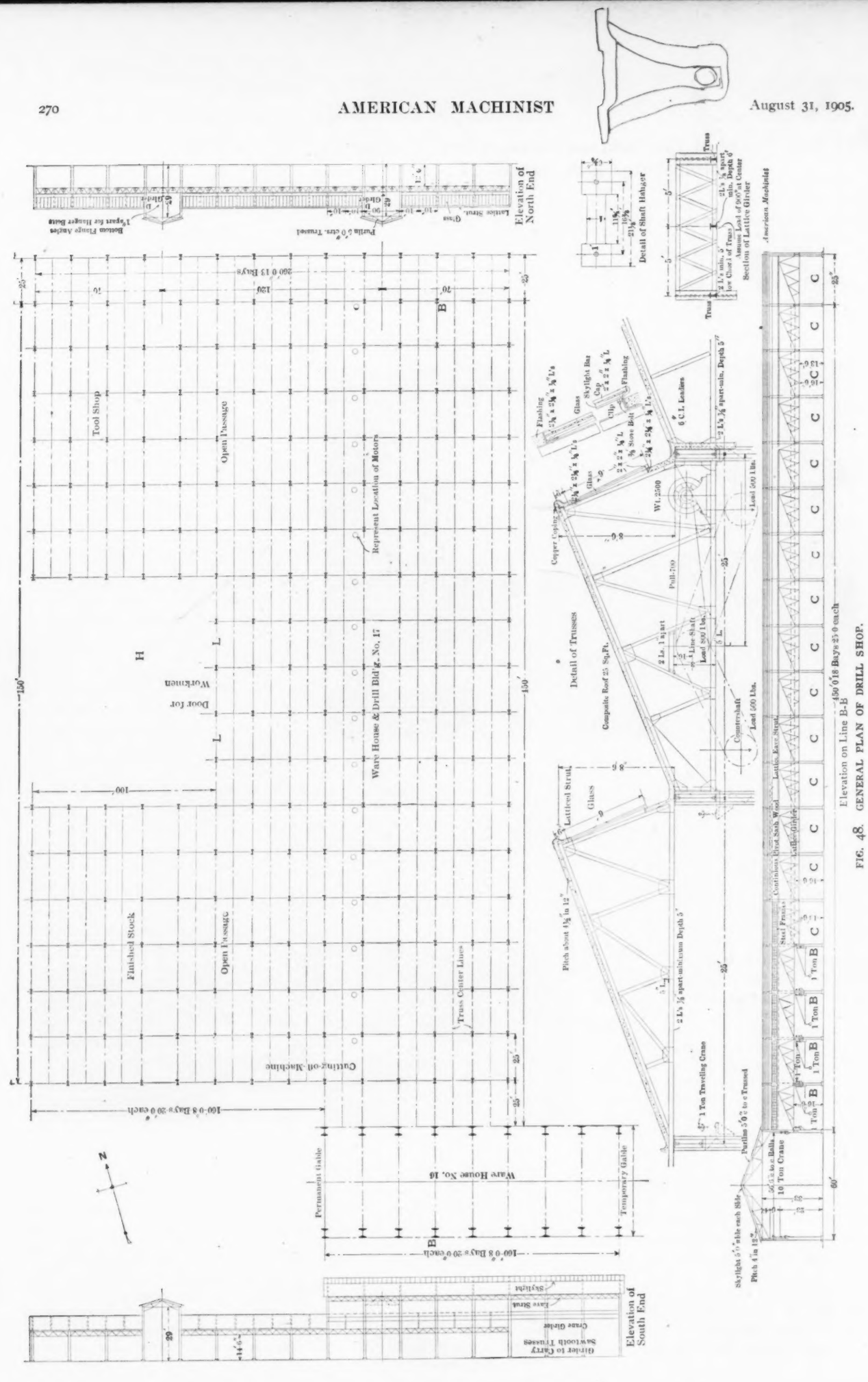


FIG. 48. GENERAL PLAN OF DRILL SHOP.

we can see. In Fig. 51 we have milling machines and Fig. 52 is the "automatic" section, which is located in the southeast corner. Fig. 53 is the department in which the feed screws are turned and threaded.

These pictures tell their own story and require scarcely a word of remark. The various departments are separated from each other by light wire screens, some of which can be discovered in the pictures, and which effectually keep the men within their proper bounds. The various departments are located with as much regard as possible to the natural succession of operations, the cutting-off machines naturally being placed next to the stock warehouse.

There are some good men who in planning this shop would have made quite a feature of the familiar narrow-gage shop railway. We may suppose, for instance, that there would have been a track running the entire length of the main passageway with a turntable at each bay and a track running through it. All this is here conspicuous by its absence. As the pictures show, there are no tracks. There is, however, an absolutely level and smooth floor, and there are trucks of various styles and sizes with easy running wheels, and these are not confined to rectilinear movements, but can be moved with equal ease in any direction, can go anywhere and everywhere. The feed-screw racks seen in Fig. 53, of course, belong to that department, but there are other trucks with larger wheels and handles to run all through the shop, or out into the drill-testing, the oil-tempering and annealing shop or elsewhere as may be required.

In looking through the pictures here shown not a single work bench is seen. There are none in the shop. The hand work is done mostly in a department by itself, at vises with iron pedestals of special design, which are fastened to the floor, so as to be accessible on every side. The vises can be raised or lowered or swung all around the circle. The bench for the workmen's tools and parts to be finished or assembled is mounted on wheels or casters, and can be placed as most convenient. R.

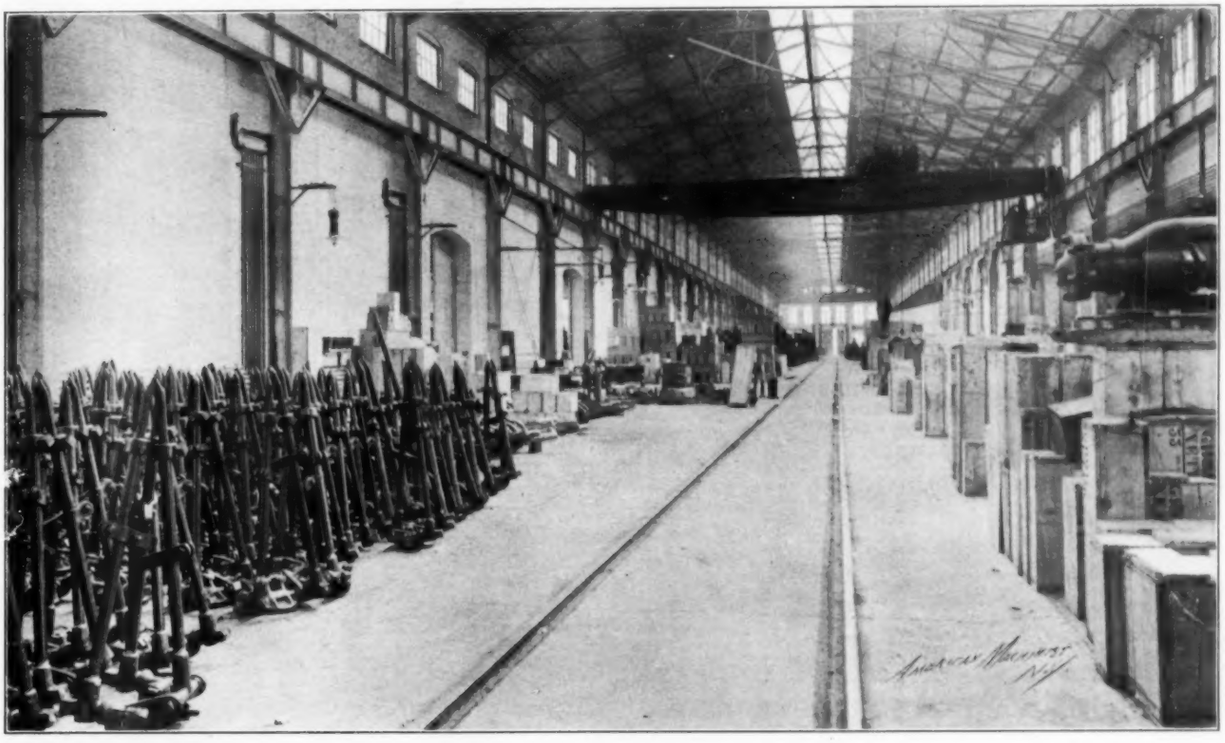


FIG. 49. STORAGE AND SHIPPING DEPARTMENT, LOOKING SOUTH.

Story of an Invention.

In a recently published autobiography of Sir Henry Bessemer is told how, in 1833, when he was a youth of twenty, he learned that the British Government was losing about $500,000 a year through the use of forged stamps. He set about finding a remedy. In nine months he discovered how to forge government stamps with the greatest ease. This was a risky bit of knowledge for a struggling young man who wanted money wherewith to get married to the girl of his choice. But young Bessemer, having invented forthwith the perforated stamp that is now known everywhere, went gayly to the government officials with the forgeries in his pocket to ask if they were genuine. When Sir Charles Presley passed them as genuine, Bessemer remarked that he knew they were forgeries—"simply because I forged them myself." Then he was informed that no superintendent of stamps would be appointed. Thus he had deprived himself of a job.

Forty-five years later, after he had invented the "Bessemer process" of preparing iron, and had made a great fortune, Bessemer wrote to Lord Beaconsfield, then Prime Minister, pointing out that he had saved the country millions without the reward of a penny. He no longer wanted money, but the government acknowledged the debt, and paid it with a knighthood. —*Chicago News.*

The Manhattan Bridge contract, just awarded to the Pennsylvania Steel Company, calls for the manufacture of 43,000 tons of steel, 8,000 tons of which will cover the wire cables and fittings.

Farm Machinery as a Factor in American Agriculture.

The following is abridged from a paper by Prof. C. J. Zintheo, of Iowa State College, which was read before Section D, Mechanical Science and Engineering, of the American Association for the Advancement of Science, at the Philadelphia meeting, December 30, 1904:

While the railroads have no doubt done their share in settling up the country, yet without modern agricultural implements no such progress could have been made as this country is able to show.

A very vivid illustration of this came to my notice a few years ago while traveling in southern Russia. Between the Black and the Caspian seas is a vast tract of exceedingly fertile country, which to-day remains to a great extent untouched by plow or farm tools. This land is on the north side of the Caucasian mountain range where Mount Ararat is located, upon which Noah's Ark is supposed to have stranded, and from which place the population of the globe began.

The reason these fertile acres are still left as verdant prairie is not for lack of population, for these were the first lands in the world's history to be settled; not for lack of railroads, for the Russian Government has built splendid railroad systems over the plains. The reason the lands have so far not been cultivated is because of the lack of proper implements with which to break up the prairie sod, and to sow, harvest and thrash grain on a large scale. The "Man with the Hoe" is able to scratch only a small portion of the soil. It requires our modern implements of tillage to cultivate our large farms of 10,000 acres.

The ever-present problem of mankind is to obtain food. The want of food has changed the map of Europe more than once. There has been no great progress in the world where food was not plentiful.

A striking contrast and one of the chief reasons why the United States is so prosperous and the Russian Empire so backward is the fact that by means of modern implements our farmers have been able to raise large crops, to supply themselves with a great abundance of food as well as luxuries, and to provide for a liberal education for their children; while the Russian peasants, with their crooked stick as a plow, with their methods of reaping the grain with the sickle and threshing it by means of having the horses trample over it, and cleaning it by throwing it against the wind, have been unable to eke out more than a bare existence, with their black bread often mixed with bark to stave off hunger. Their unhappy condition has been such that intellectual development has been impossible, and hence they remain practically where they were 400 years ago.

The importance, therefore, of the food producer in the world is manifest, and the honor due those who have done most to assist in the bounteous food supply is too often forgotten.

As late as 1845 the people of the United States did not raise enough wheat for their bread. In that year only 4 1-3 bushels per person were raised, while in 1800 there were raised 5½ bushels per person.

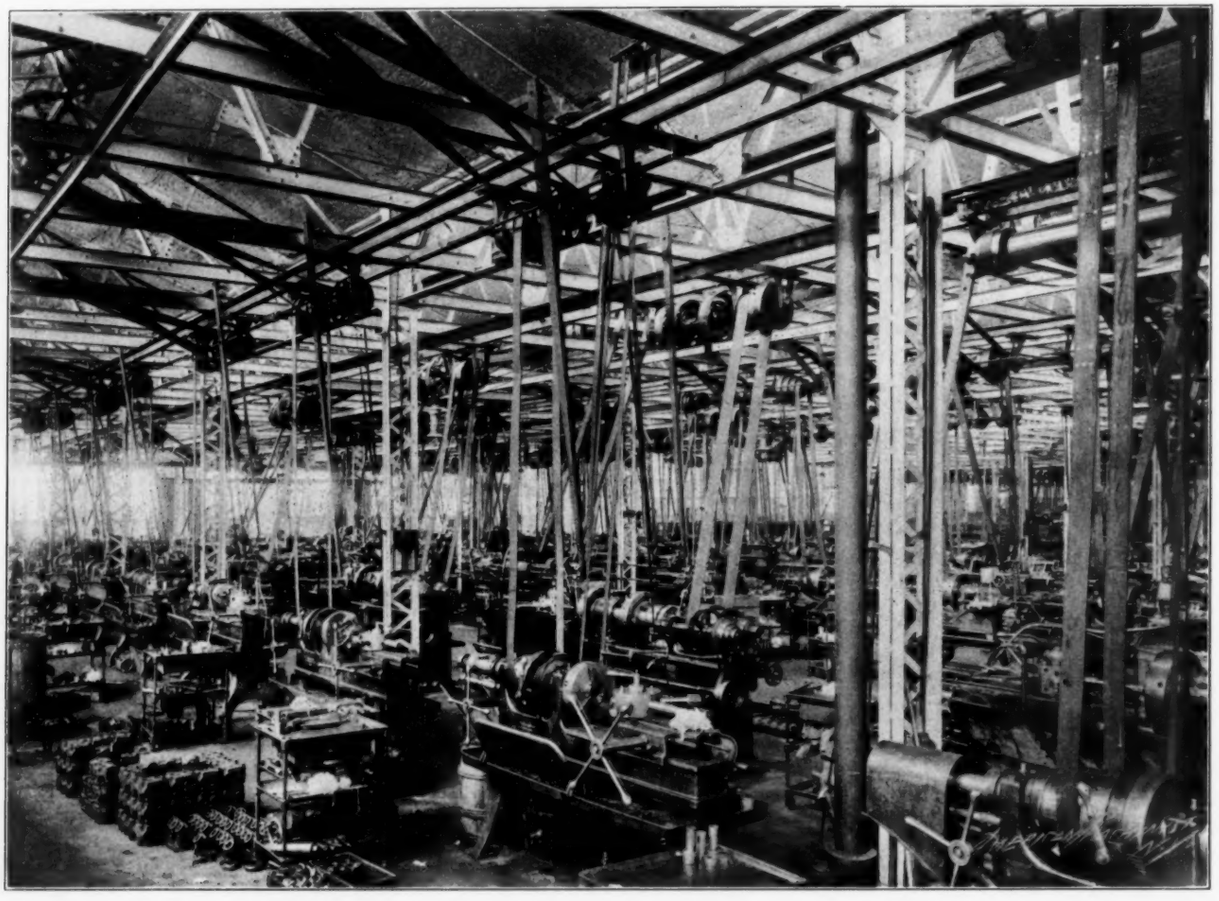


FIG. 50. TURRET-LATHE SECTION.

In the first part of the past century there were but 3 per cent. of the people living in the cities; the rest lived on the farms and in small towns. There were no large factories such as employ thousands of men to-day. With a population in the United States that had quadrupled since 1800, economists were alarmed at the failure of the food supply to keep pace with our rapid increase in population.

With the advent of the steel plow, the self-binding harvester and the steam threshing machine there was a marked change in the producing power of the American people. Our food supply increased from 4.33 bushels of wheat per

person in 1845 to 7.45 bushels in 1869, and as high as 10 bushels in 1889.

The American farmers of to-day export farm products during the present year to the value of the enormous sum of $960,000,000, according to the United States Secretary of Agriculture's report.

Much of the credit of this great achievement is no doubt due to the fertile soil of the great plains and valleys in which we live, much is due to the progressive spirit and intelligence of the farmers of America, but more is due the American geniuses who have developed the modern farm implements and have supplied our farmers with tools by which they have been able to produce more cheaply than any land under the sun, thereby enabling them to sell their products in the open markets of the world in competition with the poorly-paid laborers of Russia and India.

The plow, which has been improved from the form of the crooked stick, which merely tickled the ground, to the present moldboard or disk gang plows, with which one man and five horses can plow several acres in a day, has done much to increase the productive power of the farmer. The modern grain drills have introduced a better method of putting the seed into the ground but have not added greatly to the area that it was possible to plant, because a man could sow broadcast in a day as much as he could reap with a scythe in an entire harvest season. The introduction of the modern grain binder was the beginning of the revolution on the farm. The cotton crop can stand in the field for months after it is ready to pick, but small grains, such as wheat, oats and barley, must be harvested within a few days after they are ripe or the grain will go down and scatter, and the farmer's seed, labor and the use of his land will be lost for a year. With a machine to harvest the grain rapidly and to increase thereby the acreage which each farmer could grow, there is economy in the use of the other machinery. The self-binder is the cause of the introduction of the steam thresher, the grain drill the gang plow, and numerous other forms of modern implements.

The 80,000,000 acres of wheat, oats and barley grown in the United States make a harvester and binder so necessary that they are found on almost every farm that grows 20 acres or more of grain. On some of the large farms of the Middle West there are as high as 30 grain binders on a single farm. These binders, cutting a swath of 6 or 7 feet, work with almost human intelligence, cutting the grain, binding it into sheaves and carrying the bundles into piles which are afterward put into shocks. A binder drawn by three horses will cut as high as 20 acres in a day. There are now manufactured machines cutting a swath of 14 feet in width, and with the horses hitched behind the machine, pushing it instead of pulling.

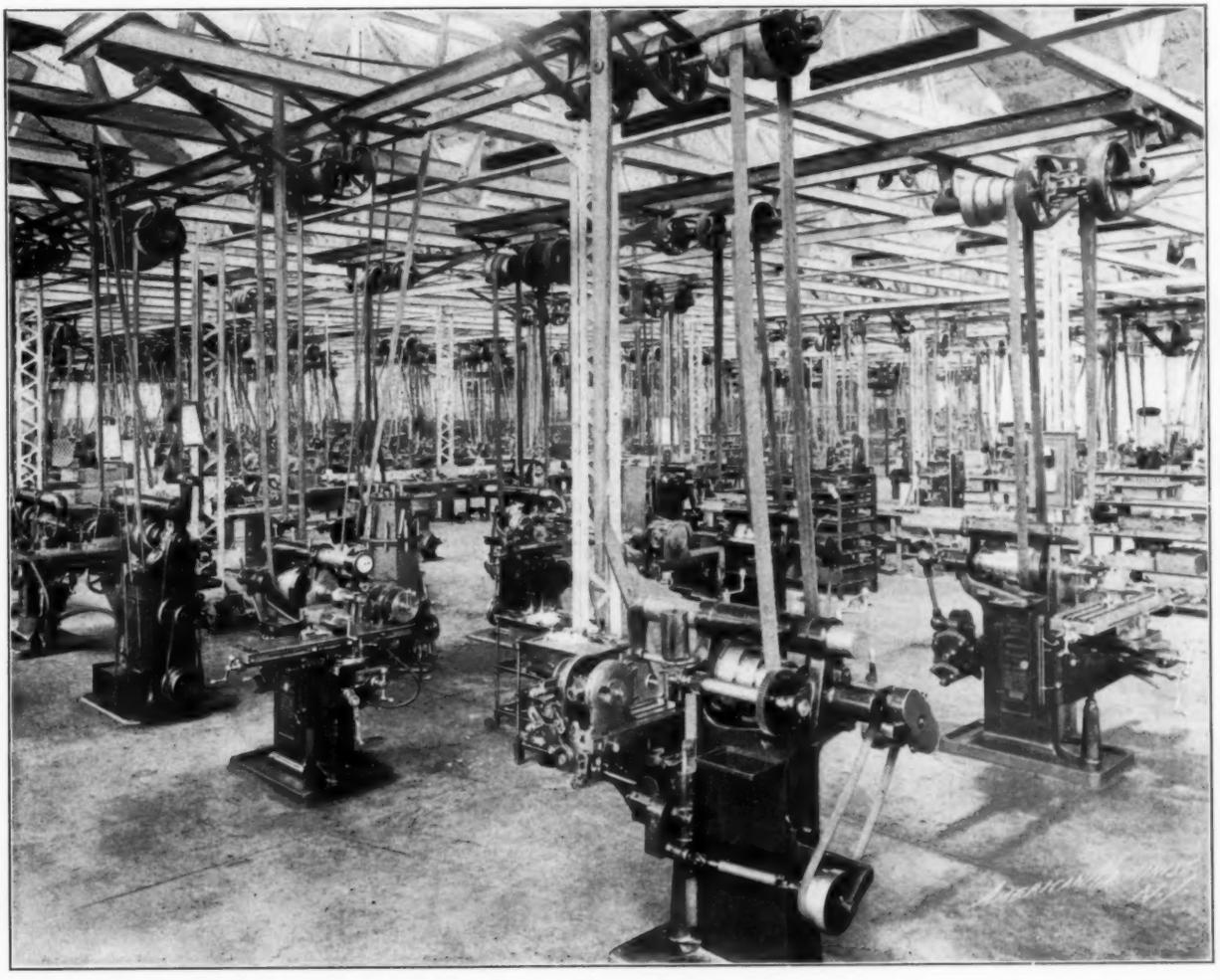


FIG. 51. MILLING MACHINES.

On some of the large farms in California, where rain never occurs in harvest time, and where the stalks of grain are so stiff that the grain never lodges, a large combined machine is used which cuts the heads off the stems, runs them into a threshing machine, where they are threshed, cleaned and sacked and the sacks dumped on the ground the same as are the bundles of the grain binder. The area in which the machines can be used is limited to the Pacific Coast country. A machine of this type, cutting a swath 18

feet wide, is pulled by from 20 to 30 horses. A still larger machine, cutting a swath 42 feet wide and pulled by a traction engine, will cut, thresh and clean the grain from over 100 acres per day.

The same traction engine which is used to propel the combined harvester and thresher is also used in plowing by hitching as many as 16 gang plows behind it. In some instances one steam engine furnishes power for plowing with disk plows followed by grain drills which sow the grain, behind which are hitched harrows to cover the grain. All the work is done in one operation and saves the labor of hundreds of men over the primitive methods.

In the great wheat region of the Middle West a steam threshing outfit is owned on all the large farms. From the early inventions of horse-tread power and separator that were introduced by Mr. Potts about 1850 and that would thresh 50 bushels per day, it is considerable progress in 50 years to the modern outfit consisting of a 25-horse-power straw-burning steam engine driving a self-feeding separator that will take grain as fast as two men can pitch the bundles to it, and thresh, clean and sack the grain, registering by means of an automatic grain weigher every bushel threshed, and its wind stacker, which blows the straw 50 feet away and forms a good stack without the attention of a man. One of these separators, requiring the attention of only one man to oil it, will thresh 3,000 bushels of wheat and from 5,000 to 6,000 bushels of oats in a day's work.

The greatest of all American crops is the corn crop. The quantity for the present year approaches 2,500,000,000 of bushels which exceeds in value $1,000,000,000. To produce such a crop and such wealth without the aid of the modern corn tools would be an impossibility. "The Man with the Hoe" formerly planted his patch of corn by removing part of the dirt with the hoe, putting in his seed and covering it by pushing on the dirt with his feet. At present the corn is planted by means of a corn planter, which opens up a furrow and drops at regular intervals three kernels of corn in every hill. By this arrangement the field becomes checkrowed, which enables the farmer to cultivate it in both directions, two rows at a time, thus cleaning out all the weeds, while he sits in a hammock seat behind the team and enjoys the summer breezes.

For years experiments were conducted to find a machine that would pick the ears from the stalks, but not until 1890 was a machine invented that would successfully bind corn bundles. Experiments were continued, until now a successful corn binder is a common thing on the farms in the corn belt. It cuts and binds the corn stalks into bundles, one row at a time, and carries them into piles ready to be put into shocks. Another machine, which is a later invention, is the corn shocker. It resembles the corn binder in its cutting and gathering devices. In place of the binding attachment, however, it has a circular revolving platform upon which the stalks are gathered. As the machine advances the platform rotates, until a shock of 100 hills or more has been accumulated. The team is then stopped, the tops tied, the shock lifted from the platform by a windlass and placed on the ground in a vertical position.

This method dispenses with the men to stand the bundles on end, but has the disadvantage that the machine must be stopped during the unloading of the shock.

The corn binder can harvest with one man and team and three shockers from 7 to 9 acres per day, while the capacity of the shocker with one man and team is from 3 to 4 acres.

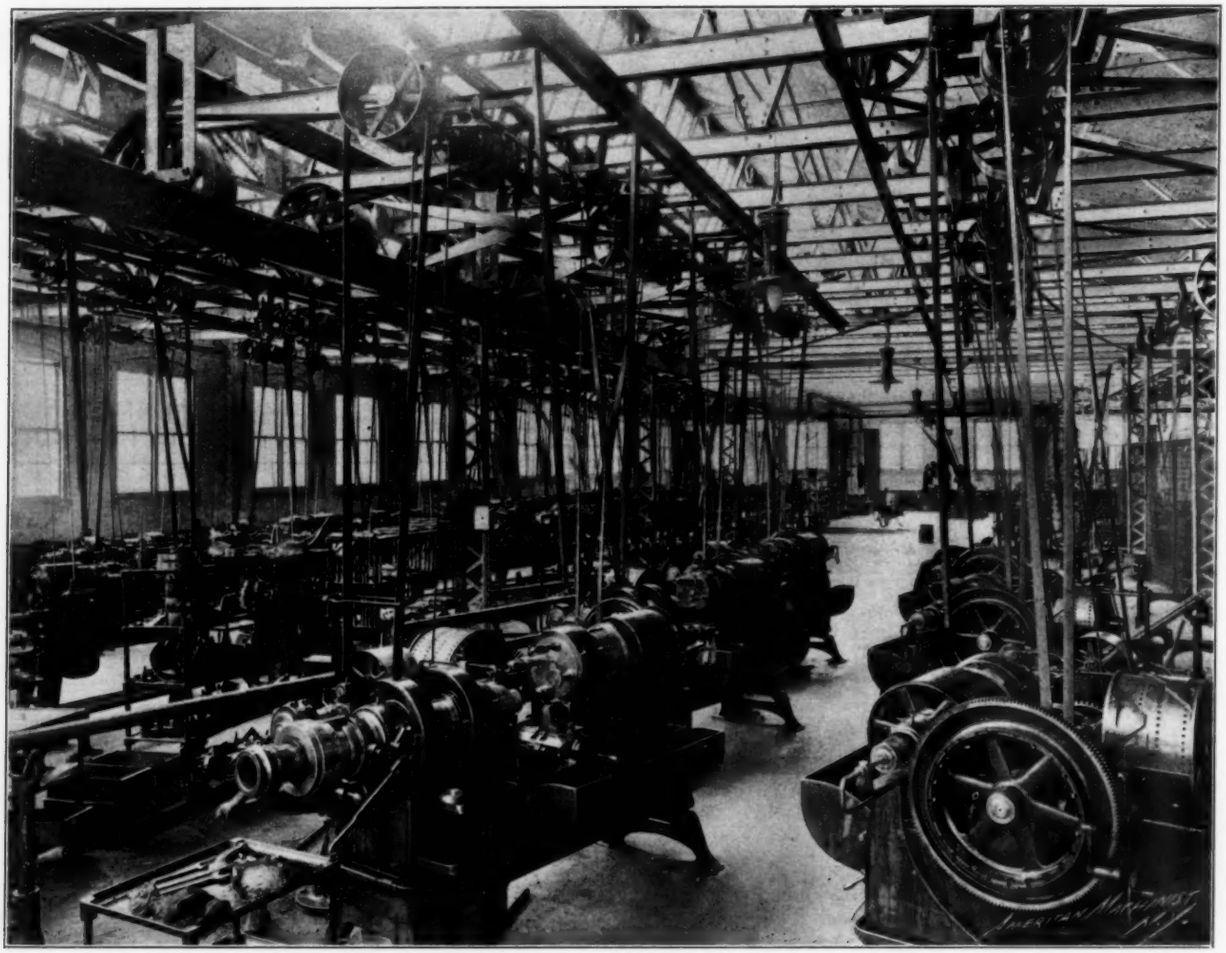


FIG. 52. AUTOMATIC TURRET LATHES.

On many farms the ears of corn are picked by hand from the stalks in the field, a team and wagon passing along the row of corn, into which the stalks are delivered.

It is estimated that 50,000,000 acres of corn are gathered in this way. The work is very disagreeable, as it is usually done in the fall and early winter when the weather is cold and often the snow is interfering. For 50 years inventors have striven to perfect a machine that would do this work, but only during the last two years has such a machine been at work successfully. The corn picker strips the ears of the stalks, which are left in the field, while the ears are husked and delivered into a wagon passing along the side of the machine.

It takes a quick man to gather a load of ears in half a day, while these machines can pick one in half an hour.

These various forms of corn planters, corn cultivators, harvesters, huskers and shredders are no doubt responsible to a large extent for the immense wealth in the 1904 crop.

Hay and wheat are contending for second place in the point of value. From the Report of the Department of Agriculture for this year it is estimated that these two crops together equal the corn crop.

Of the 50,000,000 acres of grass grown in the United States, most of it is cut with mowers, raked together with hay rakes of the modern side-delivery type, carried into the wagon by means of the hay loader and put into the mow with the automatic hay fork, to which is hitched a team. On a certain farm where these modern devices for haying were used there were put into the mow 120 tons of hay between the hours of 1 and 6 o'clock in one afternoon.

This country is the greatest maker and user of farm machinery in the world, and it is largely due to this fact that we have become the most prosperous agricultural country in the world. It has enabled the farmer to pay the high price for labor created by the competition of our manufacturers, and has taken away from farm life much of the drudgery and manual labor and made it in the best sense an intellectual pursuit. Improvements in machinery have brought about a steady decrease in the cost of production, notwithstanding the steady rise in wages. Machinery has enabled the Eastern farmer to adopt intensive farming. The windmill pumps the water used in the dairy, the centrifugal separator skims the milk, or wind-power runs the churn. In the same way it has enabled the Western farmer to plant large areas and harvest them, notwithstanding the scanty labor supply to be found there.

The total value of implements and machinery on farms in this country is $761,261,000, an average of $133 per farm and 90 cents per acre of farm land.

The American farmers buy annually $100,000,000 worth of farm implements. New designs of farm machinery are being constantly added. The manure spreader, "The Mortgage Lifter of the Farm," is making great progress as a new addition to farm tools. The gasolene engine is being used more and more for farm purposes. With it and a few attachments the farmer can pump water, shell corn, grind feed, saw wood, run the feed cutter and do an unlimited amount of things which are hard to do by hand. The making of a farm truck which will draw a plow is perhaps the next step that will be accomplished. If a gasolene engine could be put on a truck so that it could perform the work of the fields and also do the numerous jobs about the farm it would be a strong competitor with horses for farm work.

Farm machinery is surely the greatest factor in the development of American agriculture.

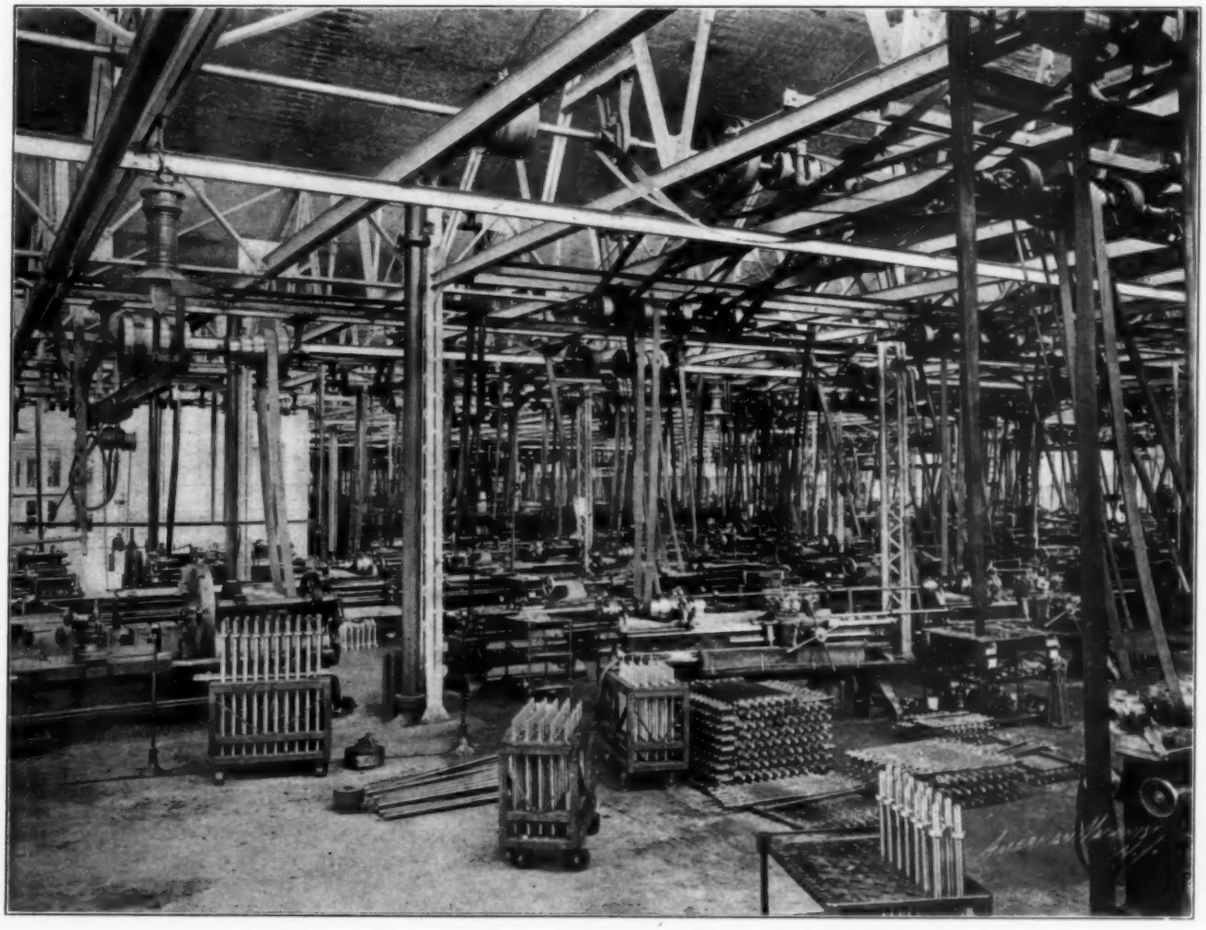


FIG. 53. FEED SCREW DEPARTMENT.

Shop Notes From Chattanooga.

EDITORIAL CORRESPONDENCE.

A BRASS-MELTING FURNACE.

Fig. 1 shows a home-made oil-burning brass-melting furnace, which is in use at the works of the Herron Pump and Foundry Company. Of the external appearance of the furnace the photograph speaks for itself. It is mounted upon trunnions, and by a pilot wheel at one end is turned over to discharge the melted metal into ladles for pouring. The burner enters through the trunnion at the end opposite the pilot wheel and is shown in detail in Fig. 2. Referring to Fig. 1, the left-hand vertical pipe is the steam, and the one at the right the oil pipe, the two being connected by a small branch and angle valve. The main oil tank is outside the building and at a level below the furnace. The service tank is located above the building and the oil is pumped to it through the vertical pipe shown which will be observed to have valves above and below the burner. Both of these valves being open and the valve in the small branch closed, the service tank may be filled, when the lower valve is closed and the furnace is ready for action. The small angle valve being opened, the oil flows into the steam-pipe and is blown into the burner through the pipe *a* of Fig. 2, which is forked at the end, each end having a small hole. The air supply is through the blast pipe, shown coming up through the floor in Fig. 1 and fitted with a blast gate. The air blast is under a pressure of 8 ounces to a pound, and enters the burner through the elbow *b*, Fig. 2. On the floor, at the left in Fig. 1, is one of the ladles used for pouring, which is heated to a proper temperature by a charcoal fire within it, this fire being blown by a branch from the air-blast pipe.

The furnace has a capacity of six heats in 10 hours, the amount of metal melted at a heat ranging between 300 and 500 pounds. It has proven so satisfactory that another one is being made of greater capacity, the increase being obtained by placing a burner at each end, the outlet for the gases being at the center, instead of one end. Fig. 3 is a section of half of this furnace which, in addition to having two burners, is to be changed from the first one by being divided lengthwise and hinged, as shown in the cross section in order to increase the facility for relining.

A COLLAPSIBLE TAP.

Fig. 4 shows a collapsible pipe tap which is in large use and in various sizes at the Herron works. The left-hand view, in which the end cover plate has been removed and the outer shell and chasers have been drawn forward, makes the construction clear. The chasers are shown in their expanded position, where they are obviously well supported. The outer shell is a running fit on the body of the tap and compels the chasers to act in unison. The collapsing of the chasers results immediately from the reversal of the tap, and they are expanded by starting the tap

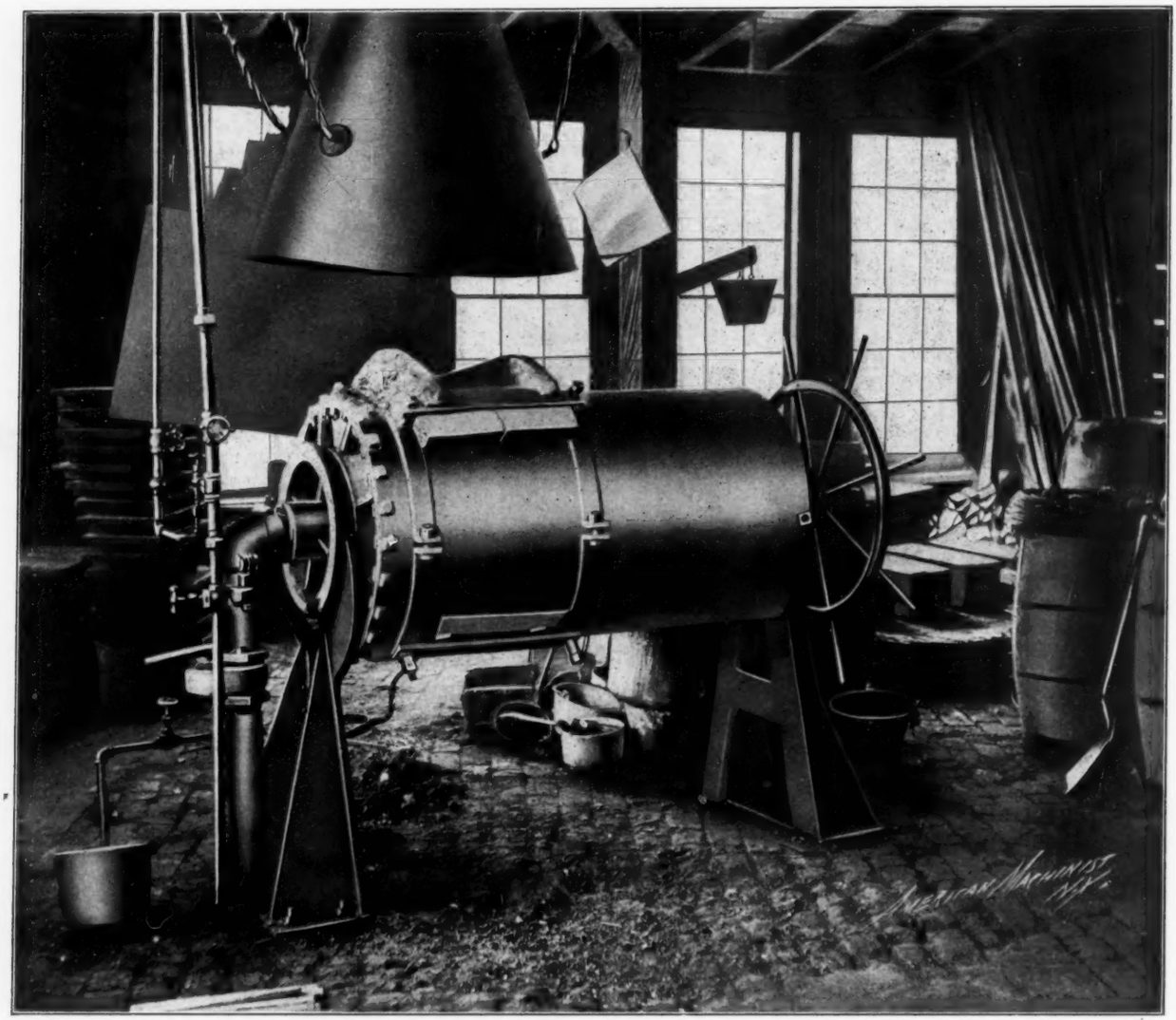


FIG. 1. OIL-BURNING BRASS-MELTING FURNACE.

in the next hole, there being no difficulty from the abrupt engaging of the teeth.

ECCENTRIC AND STRAP TURNING AND BORING FIXTURES.

Fig. 5 shows a pair of fixtures for turning spherical eccentrics and boring their straps, the eccentric fixture being in place on the lathe and the strap fixture resting on a barrel at the right. These tools are in use at the works of the Wheland Foundry & Machine Company. The tool block, which carries the two tools, is swiveled vertically in line with the center of the work, the horn shown on the eccentric fixture having no use as the fixture is now used, and the feed is accomplished by swinging the tool block on its swivel by a link connection which joins the block with the turret slide of the turret lathe. The two tools are used for the roughing cut only, the cut of one of them starting at the front and of the other at the rear side of the work. These tools are adjusted in position by a gage, and on the completion of the roughing cut one of them is removed and a finishing tool is substituted. In the case of the eccentric, the finish cut is taken to a caliper gage, which spans the work, but, because of the difficulty of gaging an internal spheri-

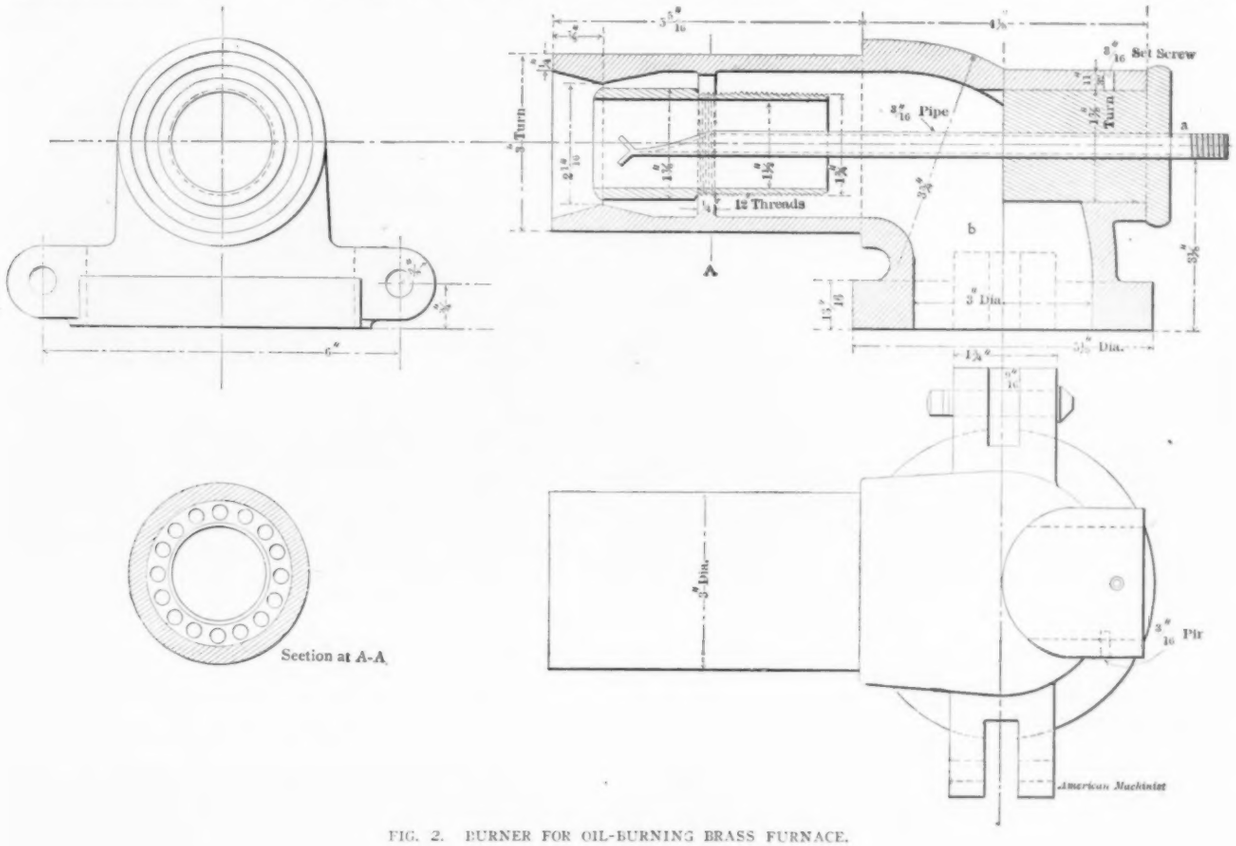


FIG. 2. BURNER FOR OIL-BURNING BRASS FURNACE.

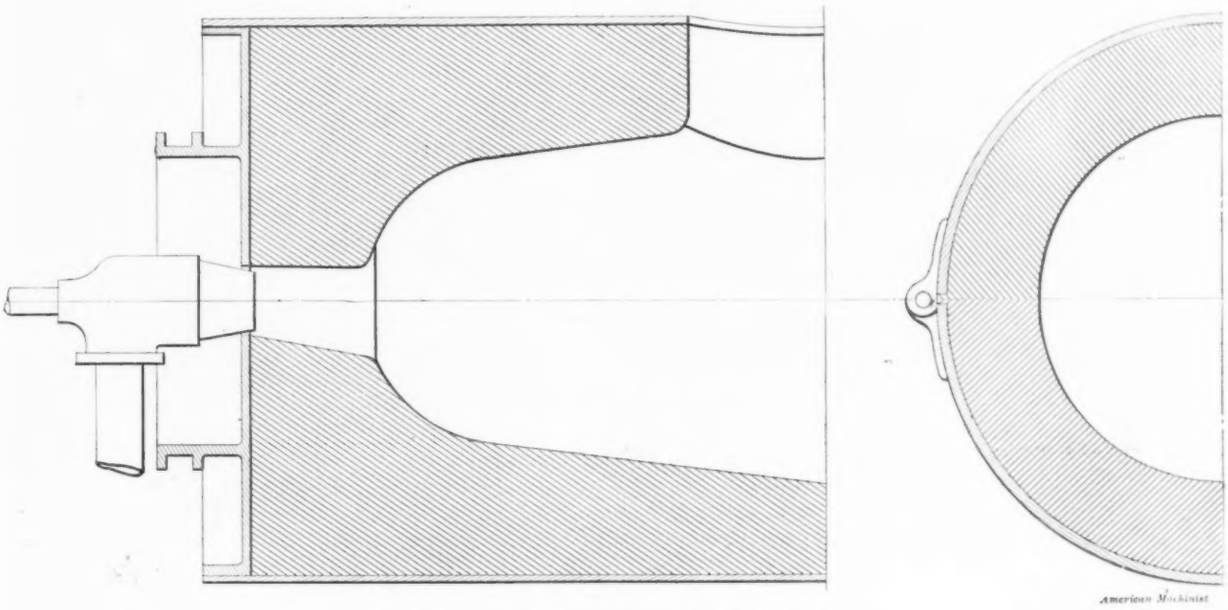


FIG. 3. SECTION OF OIL-BURNING BRASS FURNACE.

cal surface, the finishing tool of the strap-boring fixture is set to a gage before the cut is taken.

The strap-boring fixture is shown reversed from the position which it occupies on the lathe, that is, the side nearest the observer goes next the face-plate when in use. The tools are swiveled in a manner similar to that of the eccentric fixture, the stud at the right being the connection for the feed link to the turret slide.

CROSSHEAD TURNING MACHINE.

Figs. 6 and 7 show a crosshead-pin turning machine, which is in use at the same place. The four-bar pattern of crosshead is here used, the pin being cast in one with it. Fig. 6 shows a crosshead in position, with a roughing tool in place and other roughing and finishing tools placed on the crosshead, which comes to this machine with the planing finished. The supports for it are counterparts of the engine guide-bars, and hence locate it accurately in position.

Fig. 7 shows the machine without the work and with the cover of the driving gear removed. The gear is in halves, with a dovetail joint to permit the insertion of the work. Of course the length of feed possible is the distance between the sides of the crosshead, less the thickness of the ring gear, which is insufficient to turn a pin with a single pointed tool. The ring gear, therefore, has two pockets for inserting the tool blocks, the tool in each pocket extending slightly beyond the face of the ring. One tool is inserted, and rather more than half of the pin's length is roughed, when the other tool is inserted and the remainder of the pin is turned. The finishing tools have a broad face, somewhat wider than the ring, one tool thus finishing the entire surface of the pin.

A LATHE FIXTURE FOR MAKING HINDLEY WORMS.

The original worm of the above machine was of too fine a pitch to give the best results. It promptly began to heat and cut, and the entire machine gave excellent promise of being a failure. To remedy this, it was decided to replace the worm with one of the Hindley pattern,

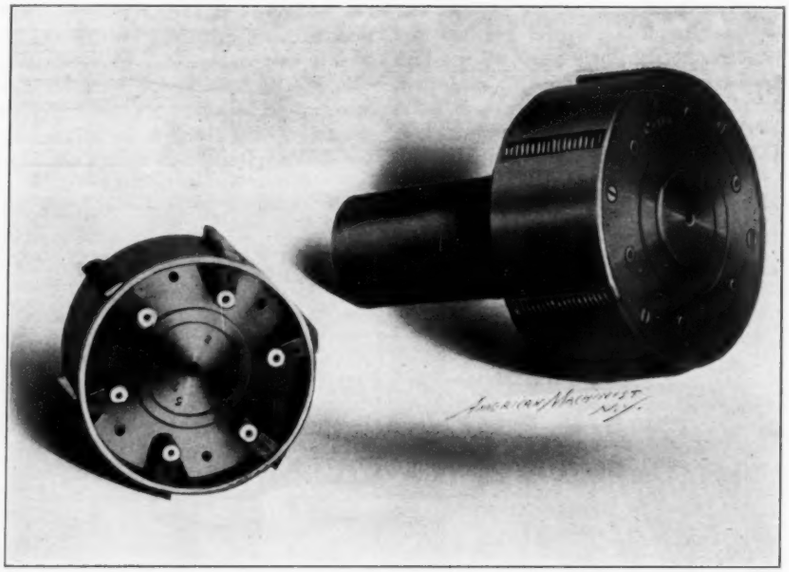


FIG. 4. COLLAPSING PIPE TAPS.

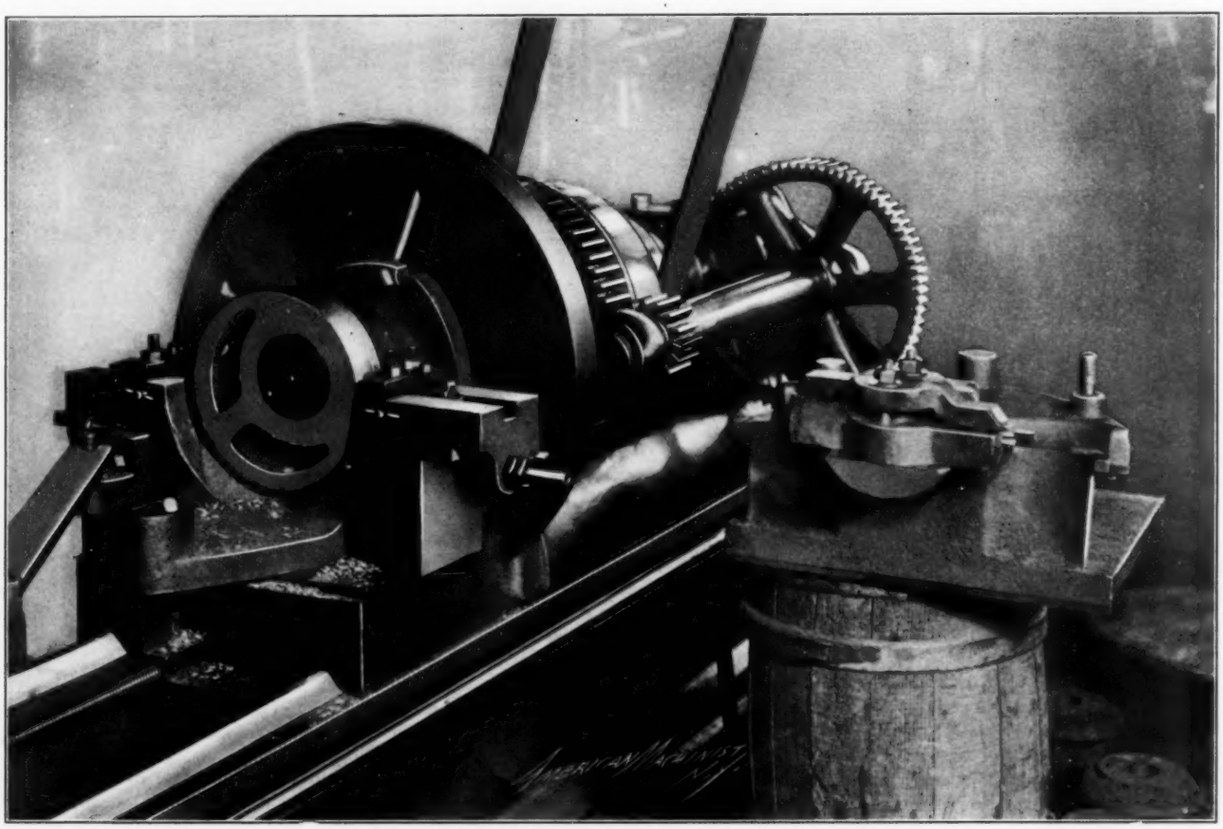


FIG. 5. FIXTURES FOR TURNING AND BORING SPHERICAL ECCENTRICS AND ECCENTRIC STRAPS.

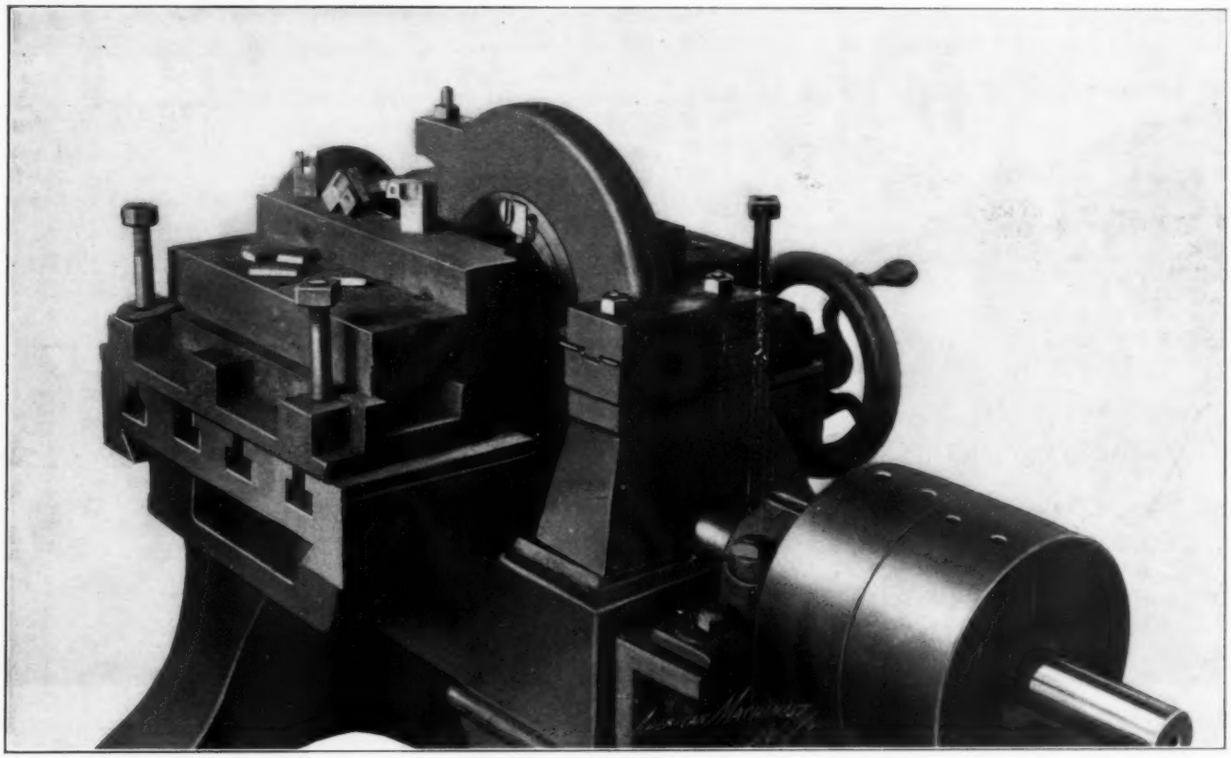


FIG. 6. CROSSHEAD PIN-TURNING MACHINE.

and Fig. 8 shows an extemporized fixture by which the Hindley worm was made.

By this fixture the worm was made in a lathe, and I doubt if this was ever done before. The fixture is certainly as nearly unique as the AMERICAN MACHINIST has often the privilege of showing.

The problem was, of course, to cause the tool to traverse the arc of a circle in order to describe the hour-glass shape of the worm, and this was accomplished by mounting it on a block which was swiveled to the tool carriage, as shown. Gear teeth were cut on the rear of this, and a short rack mounted in a suitable slide provided for swiveling the tool block on its pin. The end of the rack bar

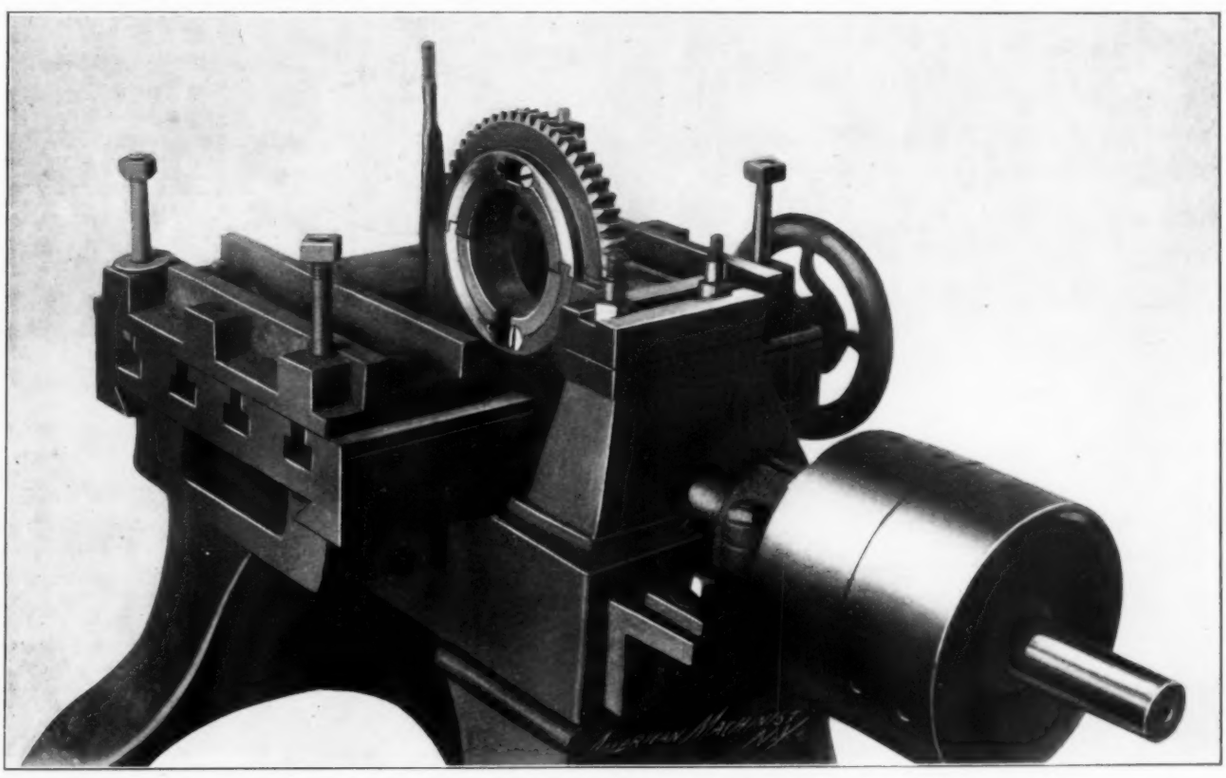


FIG. 7. CROSSHEAD PIN-TURNING MACHINE.

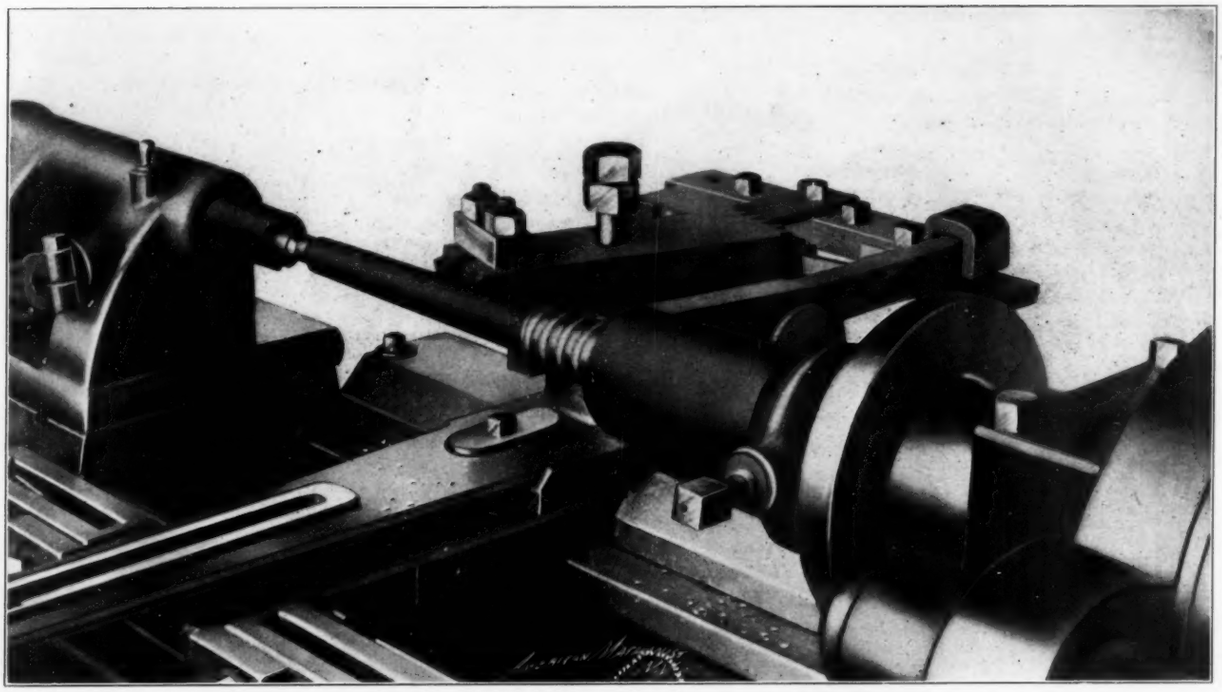


FIG. 8. LATHE FIXTURE FOR MAKING HINDLEY WORMS.

was shaped into a yoke, which embraced a rigid bar bolted to a sleeve nut which engaged a screw thread on the end of the work mandrel, this thread being of the same pitch and opposite hand to that of the desired worm. A moment's reflection will show that this fixture gave precisely the movement required. The feed of the tool inward was by the regular lathe cross-slide, the yoke on the rack end sliding on the feed-nut bar to permit this feed. The lathe was, of course, reversed between cuts. After being a failure with a plain worm, the machine was entirely successful with the Hindley worm.

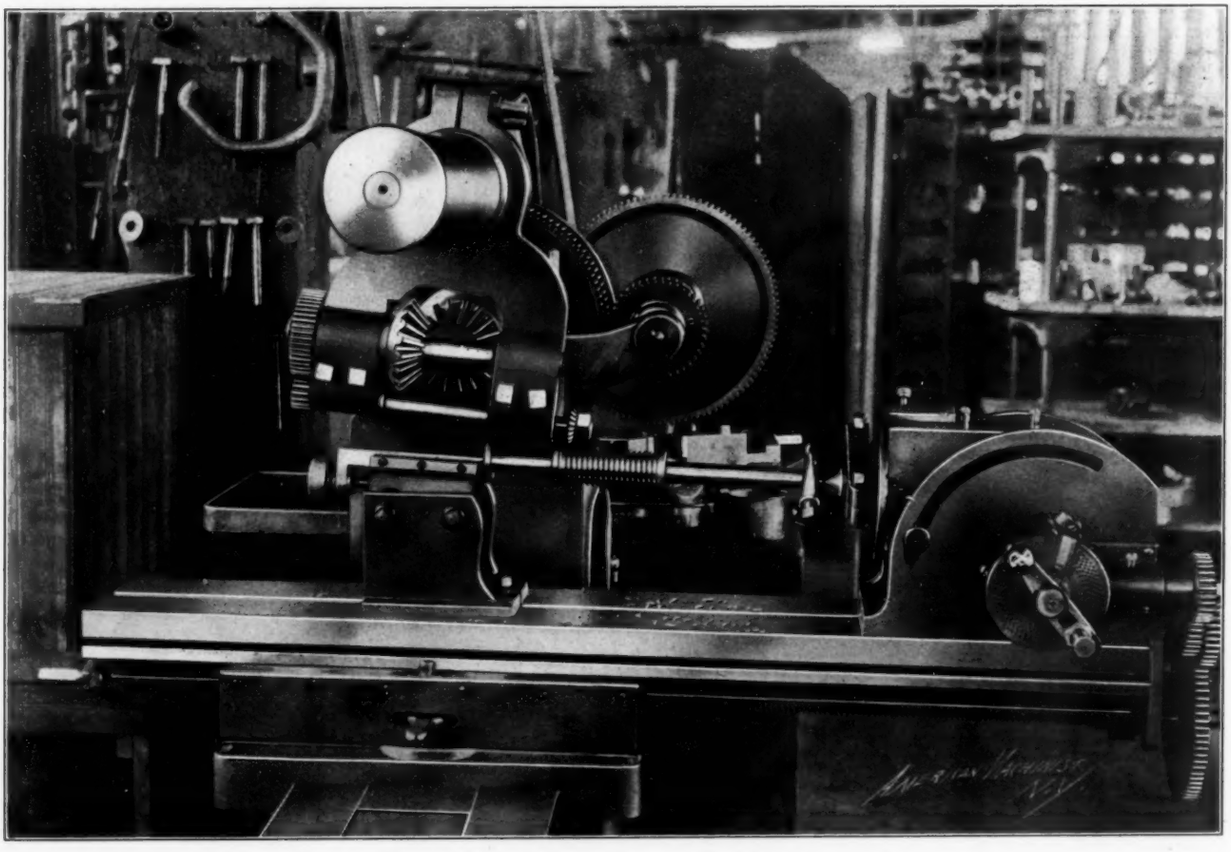


FIG. 9. CUTTING SCREWS ON THE MILLING MACHINE.

CUTTING SCREWS ON THE MILLING MACHINE.

Fig. 9 shows a fixture designed at the works of the Chattanooga Machine Company for cutting special taper screws, of which at one time it had a large number to make. The universal head was used in essentially the same manner as when cutting spirals of more usual proportions, while the cutter-driving fixture was made for the job. F. A. H.

An Oblique Worm-Drive Layout.

BY WM. H. RAEBURN.

In a very large percentage of cases of drives in general, shafts and center lines are "on the square," but there remain those cases where angular drives of one kind or another are called for. These vary in nature, but, generally speaking, the calculations in connection with them do not require anything beyond the application of simple trigonometrical rules. Occasionally, however, there is just enough about the layout to make the designer cautious, if he has not had much experience with such drives, and the drive here illustrated may be of interest to such as are not familiar with the methods employed in locating the various points and lines.

Figs. 1 and 2 show the drive in plan and elevation, and in these views are given the data on which we have to build. The worm wheels have straight teeth, formed at such angles as to properly engage the worms, and, for the sake of simplicity, are here represented as cylinders whose diameters are those of the respective pitch circles, while single lines represent the teeth. The worms are similarly represented, and all who have to deal with such will understand what is taken as the pitch diameter. The threads of the worms are formed to Brown & Sharpe standards, the addendum being the axial pitch × .3183.

It is not the intention, in this article, to locate the positions of seats or facings on the framework of the machine, but only such points and lines as will enable the necessary dimensions to be easily obtained. To simplify matters, it is well to reduce the illustrations to the form shown in Figs. 3 and 4, where the shafts are represented by their center lines and the worm wheels by circular disks tangent to those lines, the radii of these disks being the respective center distances between worm and worm-wheel shafts. It will be apparent that so long as the center distance remains constant, the diameter of the worm does not affect the position of the shaft on which it is carried, and the simplest way to consider the matter is to assume a worm whose diameter is 0. The advantages of this method will be apparent as we proceed.

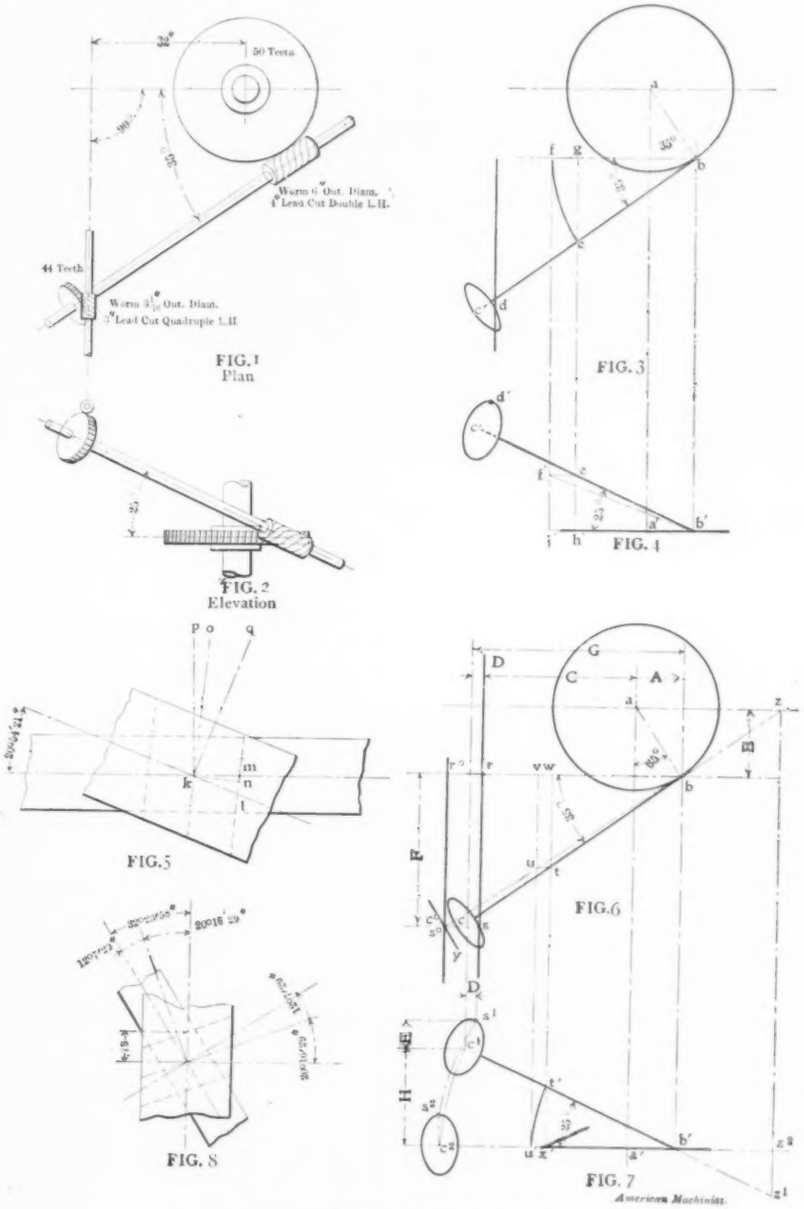
THE LARGE WORM AND WHEEL.

We shall first consider the large worm and wheel and obtain the data necessary for the construction of the latter. The worm being 6 inches outside diameter, 4 inches lead, cut double, or 2 inches pitch, the addendum is .3183 × 2 = .6366. Pitch diameter = 6″ − 1.273″ = 4.727″. Tangent of thread angle $= \frac{4}{4.727\ \pi} = .269367$, corresponding to 15° 4′ 32″.

A glance at Figs. 1 and 2 will show that we do not obtain there such a view of worm and wheel in their relative positions as will enable us to make use of the information just obtained in arriving at the wheel data. We must have a view looking in a horizontal direction at right angles to the center line of the worm shaft. We shall then see the latter lying at its true inclination to the horizontal, and we can obtain the angle at which the teeth of the wheel are placed. We can do better by considering the inclined shaft to be suitably rotated than by altering our viewpoint, so we shall proceed in that manner.

In Fig. 3 any length $b\,e$ is taken on $b\,c$, and with b as a center, the end e is swung in a horizontal plane until $b\,f$ lies parallel to the vertical plane of projection. The path along which e travels during this movement is represented in elevation by $e'\,f'$, Fig. 4, and $f'\,b'$ will lie at an angle to the horizontal equal to the true inclination of worm shaft. Assuming $b\,e$ as unity, $g\,b$ can be obtained direct from a table of natural cosines and is .81915, which is also the length of $h'\,b'$; $h'\,e'$ or $j'\,f' = .81915 \times \tan 25° = .38198$, and as $j'\,b' = f\,b = e\,b = 1$.

The former is the tangent of angle $f'\,b'\,j'$, which is 20° 54′ 21″.



LAYING OUT OBLIQUE WORM DRIVES.

In Fig. 5 the worm is represented by a cylinder 4.727 inches in diameter, as previously explained and is shown in its true position relative to the wheel, the axis of the worm being inclined to the plane of the wheel, which is horizontal, at an angle of 20° 54′ 21″. The worm threads are represented by straight lines crossing the axis of the worm at an angle $o\,k\,q$ = 15° 4′ 32″ from the line $q\,k$ at right angles to the axis. It should be noted here that these lines represent the threads on the side of the worm in contact with the wheel, and therefore show a right-hand inclination, while the worm is really left-hand. The axial pitch $k\,l$, multiplied by the cosine of the angle of thread, gives the normal pitch $k\,n$, but $k\,n$ lies at an angle below the horizontal equal to the difference between the inclination of the worm shaft and the thread angle, so that $k\,n$, divided by the cosine of this angle, gives $k\,m$, the pitch on a horizontal line, and therefore the pitch of the worm wheel.

$$k\,m = 2 \times \frac{\text{cos. } 15°\ 5'\ 32''}{\text{cos. } 5°\ 49'\ 49''} = 1.941$$

The angle 5° 49′ 49″ is that at which the teeth lie on the face of the wheel, the direction of the inclination being apparent from Fig. 5. The pitch diameter of the wheel

$$= 50 \times 1.941 \times .31831$$
$$= 30.895''$$

and the center distance of worm and wheel

$$= \frac{30.895 + 4.727}{2}$$
$$= 17.811$$

The addendum of the wheel tooth will not be fixed from the pitch on the wheel, but will be the same as the addendum of the worm thread.

USE OF LOGARITHMS.

At this point it may be in place to explain that the use of the logarithmic trigonometrical functions enables one to make calculations such as these with greater ease and less chance of error than is otherwise possible. To illustrate this let us take the foregoing calculations in connection with worm and wheel as performed by the use of logarithms:

Log. 2.....	.301030
Log. cos. 15° 4′ 32″....	9.984792
Log. sec. 5° 49′ 49″....	10.002252
Log. 1.941 cir. pitch....	.288074
Log. 50.....	1.698970
Log. .31831.....	1.502851
Log. 30.895 pitch diam..	1.489895

It will be noticed that the function for the secant of 5° 49′ 49″ is used, because multiplying by the secant is equivalent to dividing by the cosine, and so the logarithmic calculation becomes one continuous addition.

Although logarithms were used in obtaining nearly all the results here given, it is considered the better plan to give the calculations in the usual way so that those not familiar with the use of logarithms may follow clearly the different steps taken. The example just given, however, will be sufficient to show how logarithms can be used to considerable advantage.

THE SMALL WORM AND GEAR.

We shall now give our attention to the small worm and wheel. The problem they present must be handled in much the same way as that of the large pair. The outside diameter of the worm is 3 1-16 inches, the lead 3 inches, but quadruple, or ¾-inch pitch, so that the addendum is .3183 × .75 = .23873; pitch diameter = 3.0625 — 2 (.23873) = 2.585. The tangent of thread angle is $\frac{3}{2.505\,\pi}$ = .36941, corresponding to 20° 16′ 29″.

We must revolve the inclined shaft down until it is horizontal, the axis of rotation being horizontal and parallel to shaft on which the small worm is carried; for convenience the axis of rotation is taken as passing through point b.

Figs. 6 and 7 show the positions of the worm shaft, worm wheel and its shaft both before and after they are revolved down, as has been explained. When the line $b\,c$ is brought down to a horizontal plane, the disk representing the worm wheel will appear in plan as a straight line $x\,y$, and the axis of the worm shaft will cross this line at its center c^0.

It is evident that the angle $x\,c^0\,r^0$ is equal to the angle $u\,b\,v$, so we shall proceed to find the value of the latter. $b'\,t'$ is assumed as unity and revolved down to the horizontal plane as $b'\,u'$ in elevation and $b\,u$ in plan. Cos. 25° = .906308, which will be the length of $x'\,b'$ and $w\,b$;

$$w\,l \text{ or } v\,n = w\,b \text{ tan. } 35°$$
$$= .906308° \text{ tan. } 35°$$
$$= .634606$$

and as $v\,b = u'\,b' = t'\,b' = 1$, we have the tangent of the required angle $v\,b\,u$, which is found to be 32° 23′ 58″.

From the explanation given in connection with Fig. 5, there should be no difficulty in understanding how the circular pitch of the teeth of the wheel is obtained. Referring to Fig. 8, the circular pitch

$$= .75 \times \frac{\text{cos } 20°\ 6'\ 29''}{\text{cos. } 12°\ 7'\ 29''}$$

The pitch diameter of the worm wheel = 44 × .7196 × .31831 = 10.078, and the center distance between worm and wheel shafts

$$= \frac{10.078 + 2.585}{2} = 6.332$$

In order that the bearings supporting shaft $c\,b$ may be properly constructed and the shaft itself be of correct length, we must locate points b and c in relation to established center lines and also find the true distance between them.

In Fig. 6 the distance

$$A = a\,b \times \text{sin. } 35°$$
$$= 17.811 \times \text{sin. } 35°$$
$$= 10.216$$

and distance

$$B = 17.811 \times \text{cos. } 35°$$
$$= 14.95$$

We are given C = 32, but when the shaft $b\,c$ is inclined in its proper position in the machine, the contact point s is not vertically over the center of the worm wheel, but at a distance to the right

$$D = s'\,c' \times \text{sin. } 25°$$
$$= 6.332 \times \text{sin. } 25°$$
$$= 2.676$$

Point s, the intersection of the axis of the worm shaft and the central plane of the worm wheel, moves at right angles to the former in plan as the inclined shaft is revolved on the imaginary horizontal axis passing through b. Adding A, C and D together we have G = 44.892, from which we find

$$F = 44.892 \times \text{tan. } 35°$$
$$= 31.434$$

Again, $b\,c = \frac{G}{\text{cos. } 35°}$ but this is not the true distance between points b and c, as the line is inclined to the horizontal at an angle of 20° 54′ 21″; so that the true length = $\frac{44.892}{\text{cos. } 35° \times \text{cos. } 20°\ 54'\ 21''}$, or 44.892 × sec. 35° × sec. 20° 54′ 21″ = 58.665.

This distance could be obtained in another way, and it is just as well in cases like this to take advantage of such a check.

In Fig. 7,

$$c'\,b' = \frac{G}{\text{cos. } 25°}$$
$$= \frac{44\ 892}{\text{cos. } 25°}$$
$$= 49.\ 533$$

and $c'\,b' = c^3\,b' = r^0\,b$, Fig. 6. $c^0\,b$ shows the true length of $c\,b$ and

$$= \frac{49\ 533}{\text{cos. } 32°\ 23'\ 58''} = 58\ 665$$

the same result as obtained above.

There remain the distances H and E, Fig. 7, to be calculated.

$$H = G \times \text{tan. } 25°$$
$$= 44.892 \times \text{tan. } 25°$$
$$= 20.934$$
$$E = s'\,c'. \times \text{cos. } 25°$$
$$= 6.332 \times \text{cos. } 25°$$
$$= 5.739$$

It is also well to locate the intersection point z:

$$a\,z = \frac{a\,b}{\text{sin. } 35°}$$
$$= \frac{17\ 811}{\text{sin. } 35°}$$
$$= 31.0525$$
$$b\,z = a\,b \times \text{tan. } 55°$$
$$= 17.811 \times \text{tan. } 55°$$
$$= 25.437$$
$$z'\,z^2 = a\,z - A \times \text{tan. } 25°$$
$$= (31.0525 - 10.216) \times \text{tan. } 25°$$
$$= 20.837 \times \text{tan. } 25°$$
$$= 9.716$$

The true distance between points b and z would be found by dividing the length

$b\,s$ in plan by the cosine of the true angle of inclination to the horizontal,

$$\frac{24.437}{\text{cos. } 20^{\circ}\ 54'\ 21''} = 27.229.$$

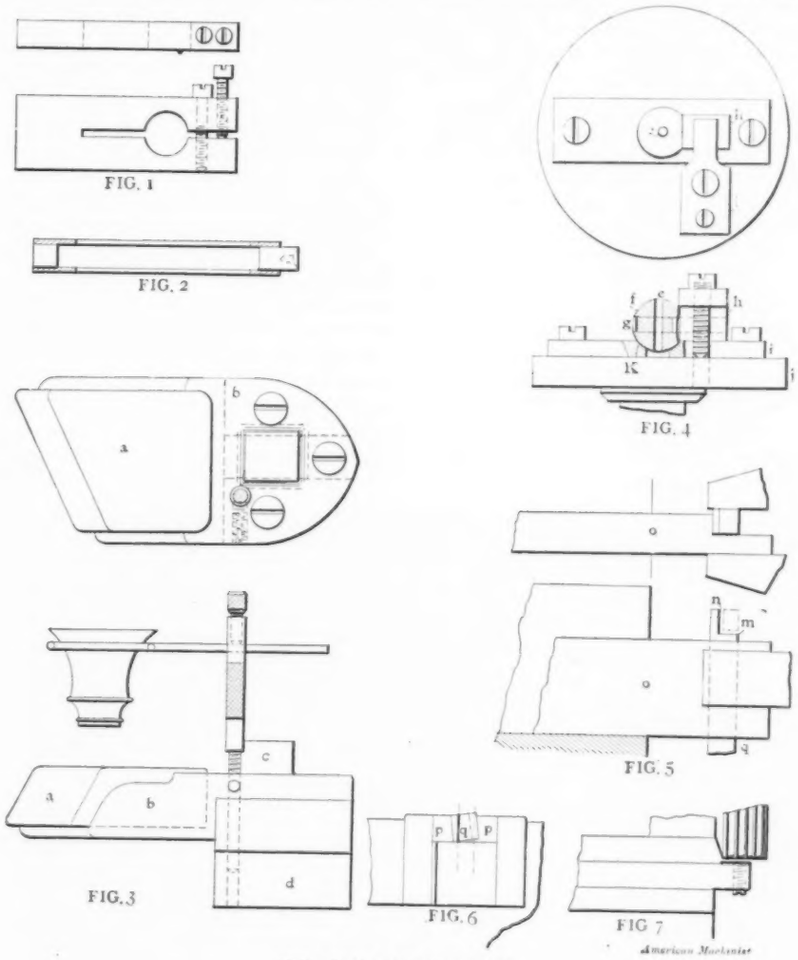
It has not been mentioned, but it will be easily seen that points b and s are at the centers of the lengths of the large and small worms, so that the shafts carrying them and the bearings for these shafts can be constructed from the dimensions found by the foregoing calculations. It may have been observed that the lines representing the threads of the worms do not correspond in inclination with those that would be used in the conventional method of representation of double and quadruple threads. A little thought makes the reason clear; the angles at which the lines are drawn here represent the true angles of the thread helices with the axes. If the threads were represented by helical curves—as they actually appear—the angles would be those of the curves at the points where they cross the axes. When the conventional method is used, the thread angle appears greater than it actually is, and of course such would not suit our purpose here. To some it may have seemed that unnecessary refinement has been adhered to in the dimensions calculated in this article; but, while we admit that such is often useless, it is perhaps as well, when results are interdependent, to err on the safe side, especially when there is little extra labor involved in getting the third or fourth decimal figure.

Dundas, Canada.

Shop Tools and Methods.

BY F. LE CARD.

A cheap and effective tool for lapping round work is shown in Fig. 1. It admits of quite an adjustment before it is worn out of shape, and can then be opened with a counterbore for larger size work. It can be opened or closed for quite a range with the two screws, as shown. Fig. 2 represents a style of lap for holes which is used quite extensively in some shops on very nice work. It is made of the regular size commercial brass tubing slitted with a fine saw and plugged at the ends with wood. The tube is filled with cotton waste and by driving in the plug a limited expansion is obtained.



SHOP TOOLS AND METHODS.

A FILING PAD WITH EYEGLASS ATTACHED.

The S. S. White Dental Tool Company sells two sizes of bench filing pads like that shown in Fig. 3. The pad a is made of soft rubber and pressed into the gray-iron frame b. The latter has a chilled anvil c, and screw holes for securing it to the edge of the bench. For my own use I arranged one as shown, with a wooden block d screwed to the casting to form a means of catching in the vise. I prefer this to having it fast on the bench as I use a Billings & Spencer bench hand vise for small work and readily catch the block at d in this.

I have shown the use of a double eye-glass not generally known to the craft. The glass is useful for backing off delicate counterbores, mills, etc. But when held in the eye, the focus being so short, the fingers and nose as well as the file are too crowded for practical work. By holding the double glass as shown, a single glass may be held in the eye socket and used to good advantage in combination with the other glass; and this leaves room for the hands to work freely. Many persons who find it difficult to hold a glass by the muscles near the eye may find the reason in the size of the rim of the glass. Try several sizes before giving up.

PUTTING A HOLE THROUGH THE CENTER OF A BALL.

Fig. 4 shows a method I used with the best of results for putting a hole e through the ball f and hole g, at right angles to the shank h on f. I clamped the piece i to face-plate j, bored out a 40-degree recess h for the ball to rest in until the shank h rested on the plate i with no lost motion of the ball in its seat, then clamped the shank with strap l, and bored and reamed out hole e carefully.

MAKING CUTTING-OFF TOOLS.

Fig. 5 shows a use I frequently make of the power hack-saw. I had a dozen cutting-off tools to make on a high-grade steel—Styrian, I think—that was quite trying on milling-machine cutters. After cutting off a piece in the horizontal way, I sank the saw as seen at m, then clamped the stock to an auxiliary piece o and cut out the waste at n, holding the work vertically.

Figs. 6 and 7 show how to hold the stock in the miller vise to get the clearance on both sides of the blade alike. Use a pair of parallels with the angle needed on one side. Make the parallels by getting the angle on one side of a strip and then cut it in two. Hold the work in the vise, as shown in Fig. 7 and mill one side as in Fig. 6. Then simply turn the stock around in the vise and mill at the opposite side of the vise.

As the blades I made were thin I backed them up with a stop screw in one of the parallels, as seen in Fig. 7. The dozen cutting-off tools were easily made alike.

During the heavy storms of last April, 113 ships, 36 of them steamers, were lost, and 376 ships suffered damage.

Letters to the Editor.

A New Kink for Making a Strong Box.

We had occasion to make some boxes for shipping a cylinder reboring rig, in which it was desirable to have the boxes so they could be used over and over again.

The plan adopted was to make the outside at the ends tapering and hoop them with iron hoops that could be driven on

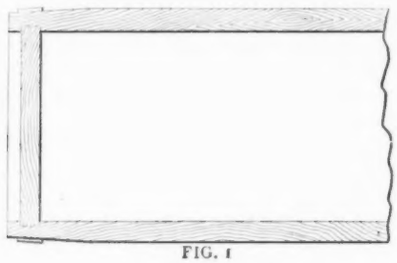


FIG. 1

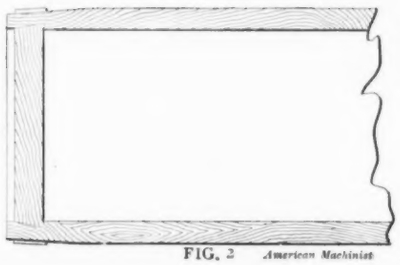


FIG. 2 *American Machinist*

and off like the hoops of a barrel. Then the question was how to put in the heads so that when chucking the boxes around the heavy parts inside would not knock the heads out. Crozing in the heads as shown in Fig. 1 would not do as the chime would be sure to split out and the plan shown in Fig. 2 was adopted. It is hardly necessary to say the plan worked.

J. E. S.

Standard Screw Slots.

Is there a standard for screw slots? I have looked through all the hand-books and screw catalogues I could find, and every place available where data on the subject are likely to be found, but I have been unable to find dimensions of screw slots given by any authority. A kick came recently from the shop, the superintendent asking, "Where do you get your sizes for screw slots?" The reply given was that they were not dimensioned on the drawings, as it had been the custom of the drawing room, ever since the plant had been running, to leave that matter to the judgment of the shop.

We agreed that the slots should be dimensioned, but no one seemed to be anxious to shoulder the responsibility of stating the sizes. In looking over the machines in use in the shop, we found hardly two screws of the same size with like slots. On ¼-inch screws the width varied from 1-16 inch to 5-64 inch, and were of all depths. The foreman of the automatic department was asked where he got the sizes, and he replied that the man running the machine looked after that. Upon inquiring of the operator, he said, "Oh, I just make them so they look about right." As a consequence, scarcely two lots of the same size screw were slotted alike.

An old mechanic in the shop heard that we had up the subject of screw slots, and gave us the table shown. He said it was used in a shop in which he once worked, and, so far as he knew, it was their standard only, and covered only the sizes they used.

It seems as though it should be unnecessary to grind a little off a screwdriver or hunt a heavier one to avoid spoiling the slots because they vary so widely. Every screw that is used frequently in the shop looks like a plow furrow. Will someone venture information on the subject? It may seem of little consequence to some who read this, but I contend that sometimes it is important, and often it would save time to know of a standard, if there is one, and there is always satisfaction in knowing that the size is correct, and not mere guesswork.

L. F. B.

[Both the Brown & Sharpe and the Pratt & Whitney catalogues contain tables of screw slotting cutters, giving the widths of saws to use for different sizes of screw heads; and Saunders' "Hand Book of Practical Mechanics" contains some data on this subject. Also at page 810, Part I, a very complete table is presented, giving the practice of the General Electric Company in regard to shape and size of screw heads, and width and depth of slots.—Ed.]

SCREW-SLOT DIMENSIONS.

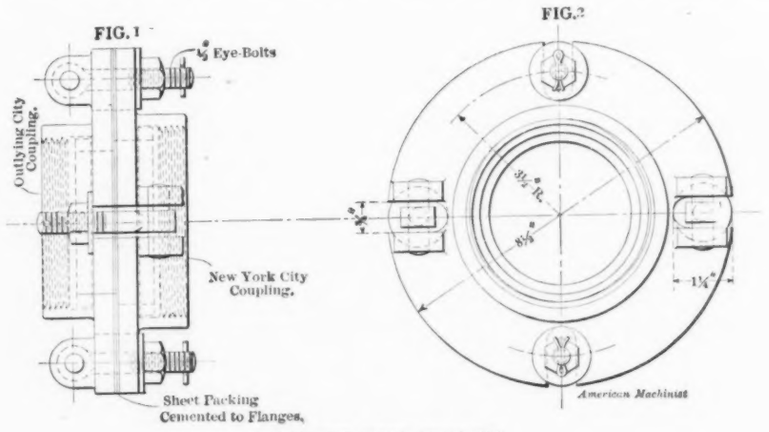
Size of Screw.	No. of Saw.	Width of Slot.	Depth of Slot.
4	20	.032"	3/64"
6	20	.032"	3/64"
7/32"	20	.032"	1/16"
8	18	.040"	1/16"
10	18	.040"	1/16"
1/4"	17	.045"	1/16"
5/16"	17	.045"	1/16"
3/8"	14	.064"	3/32"
7/16"	14	.064"	3/32"
1/2"	12	.081"	1/8"
9/16"	11	.091"	3/32"
5/8"	11	.091"	3/32"

A Proposed Hose Coupling.

Your article at page 101 of Part II in regard to action of the Board of Supervising Inspectors of the United States Steamboat Inspection Service as to use of standard pipe-thread hose couplings, forces me to offer a suggestion that I have for some time been looking for others, more directly interested, to offer. This question has come up several times in the last few years in your columns, and the remedy seems only too apparent and simple. It is a matter of surprise that the Baltimore conflagration has not already forced some such device into general use, by cities in the East, where the distances between are short.

The enclosed sketch should require little description, except that each hose company should carry one or two of these devices, or halves of a flange coupling, of its own standard thread or style of hose connection, of sufficient diameter of flange to permit of the bolt washers clearing the hub of the flange on the largest hydrant suction size; and the engine company should carry one of the large size, threaded to its own suction pipe or steamer opening of hydrants. The home companies lending their half of the flange couplings to couple to the hydrants of their own system, puts the system into interchangeability for any foreign apparatus.

In cities using more than one size of hose, as is the case here in Detroit, these flange couplings can be made to serve the purpose of reducers, and also make it possible to attach a line to the suction plug of the hydrant in case of breakdown of an engine, thus increasing their range of usefulness.



A PROPOSED HOSE COUPLING.

It only remains for the fire chiefs in convention to adopt some such plan and also to fix upon the maximum diameter of flanges and eyebolts the minimum radius of eyebolt centers, the width and depth of slots, none of which requires a close range of accuracy, like the fit of a thread or a clamp coupling.

W. B. Norton.

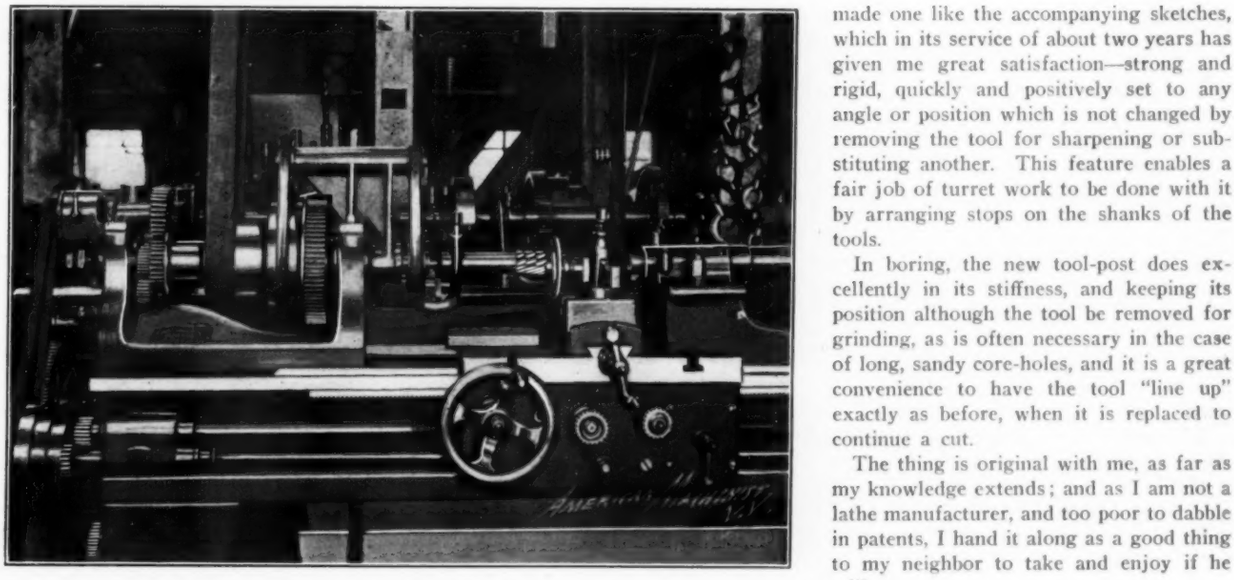
Detroit, Mich.

A Lathe Arranged for Grinding.

The accompanying photograph shows how an old lathe at comparatively small outlay was very nicely and satisfactorily arranged to do our grinding, which was not extensive.

The bracket bearing, shown on the front spindle bearing of the lathe, was made to fasten on top of the lathe box cap. The lower end of the casting had a hole bored to fit freely over the spindle end. Both edges of this end were faced up, the inner edge abutting against the collar of the lathe spindle, and the whole was held in place by a ring nut threaded to fit the lathe spindle, and by the two cap screws in the foot. The upper end of the casting, or the upper spindle bearing, was chamfered to permit of babbitting that spindle.

The gear box on the spindle tail bearing is comprised of the old, familiar bevel gear reverse movement, and is too well known to need any lengthy description here. It was intended at first to make the carriage carrying the grinder, with automatic reverse by means of a rod lying on top of the lathe bed next to the headstock and inside the outer "V," and also passing under the saddle, having adjustable tappet blocks, one on each side of the saddle, then connecting by a lever fulcrumed at the tail end of the headstock and connecting with the clutch inside the reversing gear box by means of the clutch cam stem having the small handle, as



A LATHE ARRANGED FOR GRINDING.

shown in the photograph. This detail was delayed, however, from time to time, on account of rush jobs for the machine, and in the meantime the photograph was taken. It will be noticed that the spindle of this gear box derives its motion from the cone gear of the lathe, the reversing spindle being provided with a pulley belted to another of larger diameter on the friction feed shaft of the lathe carriage. The belt connections can be clearly seen.

The lathe spindle is stationary while the cone runs free and transmits motion to the bracket spindle, as shown. This spindle in turn transmits motion to a pulley, which constitutes the work driver, running on a spindle which is fitted to the regular tapered center hole in the end of the lathe spindle and having its own work center. It will be readily understood that the arrangement gives us the "dead centers" as used on all regular grinding machines. It was but a matter of a few moments to change from a grinder to the lathe and *vice versa;* which fact, owing to the conditions of the department, was appreciated and, as far as our requirements were concerned, it answered quite as well as a more expensive machine.

Brooklyn, N. Y. H. J. WHITE.

A Turret Tool-Post.

Having reached the limit of patient endurance with my old, wabbly tool-post, I made one like the accompanying sketches, which in its service of about two years has given me great satisfaction—strong and rigid, quickly and positively set to any angle or position which is not changed by removing the tool for sharpening or substituting another. This feature enables a fair job of turret work to be done with it by arranging stops on the shanks of the tools.

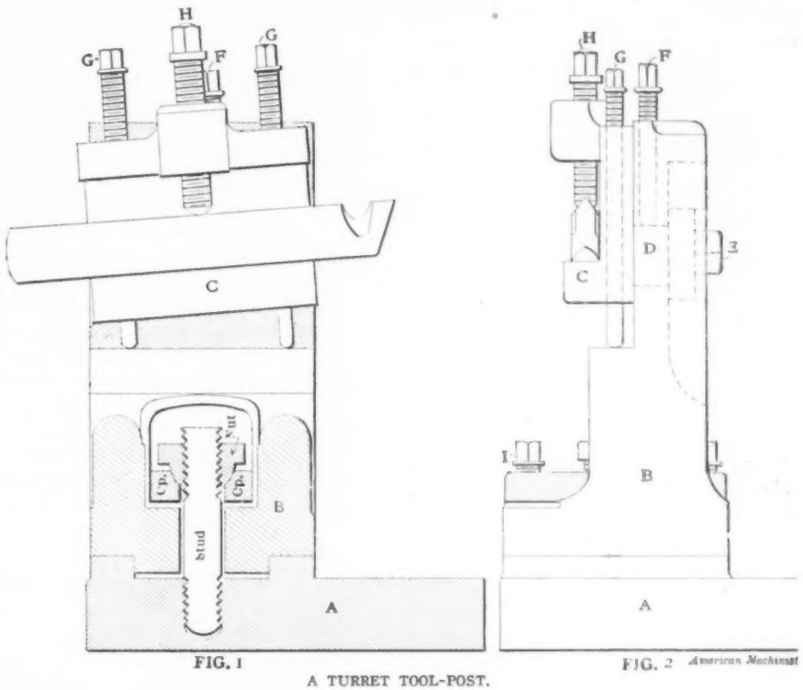


FIG. 1 FIG. 2 American Machinist

A TURRET TOOL-POST.

In boring, the new tool-post does excellently in its stiffness, and keeping its position although the tool be removed for grinding, as is often necessary in the case of long, sandy core-holes, and it is a great convenience to have the tool "line up" exactly as before, when it is replaced to continue a cut.

The thing is original with me, as far as my knowledge extends; and as I am not a lathe manufacturer, and too poor to dabble in patents, I hand it along as a good thing to my neighbor to take and enjoy if he will.

At Fig. 1 the details of the swivel are shown in section. *A* is the tool-slide upon which the tool-holder *B* swivels; the set-screw *I* clamps the swivel. The tool is held in the tool-plate *C*, which swivels on the projection *D*, fitting a recess in *B*. *C* is held in position—when the correct adjustment of the tool has been obtained—by the clamp-screw *E* and the set-screw *F*.

The set-screws *G* reach through the tool-plate *C* and bear against *B;* by adjusting them the tool is set to correct height. The set-screw *H* holds the tool.

MAURICE R. WILLIAMS.

"A Present Help in Time of Trouble."

At page 192, Part II, salesman says, among other things, "Some men say 'I have no place to file away mechanical papers, they accumulate so fast.'"

While I have found the above to be my experience also, I have overcome this obstacle (if it may be called such) by cutting out the various articles pertaining to the class of work that I am engaged in, or any other articles that I believe will be of service to me in the future. These articles can be filed in comparatively little space. The up-to-date mechanical paper is valuable to the reader not only in the present, but in the future as well. From personal experience I know this to be true, as the following incident will bear witness:

I was at one time employed as a die-maker for a brass novelty concern, and when this incident took place I was comparatively a new man, and, like all new men, very anxious to make good. One day, just before quitting time, the "Old Man" gave me a job, saying, "Here's a job that I thought we could do in one operation, but I find it can't be done, so I will start you on the first operation and Brown on the second," and then he proceeded to tell me how he wanted the tools for the first operation made.

As soon as I saw the sample that we were to work by, it reminded me of a job that I had seen described in the columns of the AMERICAN MACHINIST some little time before, showing a set of tools that made in one operation something similar to what we were now going to make. I did not say anything, but I felt sure that the idea as shown in the MACHINIST could be used on this job. So that night I got out my "clippings," and, sure enough, there was the one that I knew I had saved, describing an idea that I was now positive could be used in our case.

I immediately got to work and made a few rough sketches showing how we could do our job in one operation by using, with a few minor changes, the idea referred to and brought them along the next morning.

Now the "Old Man" was one of those who are willing to listen to suggestions, and, as he was well liked by his men, I did not hesitate to show him the sketches and tell him that I thought we could do the job in one operation. To make a long story short, he told me to go ahead, and go ahead I did. In two weeks, with the aid of an apprentice who did the roughing out, I had those tools done and they worked O. K.; not only that, but the idea has since been used on other jobs.

Incidentally I may add that my pay was raised very shortly after, and I have more firmly believed ever since that the value of a reliable trade paper lies not only in the information it may furnish to-day, but in the assistance it may render to-morrow as well.

C. F. EMERSON.

Machining Crankshafts for Motor Wagons.

The crankshafts shown in Fig. 4 are required for motor wagons. We were building half a dozen motor wagon engines, and required the same number of crankshafts. Further, we expected more orders, and desired to make the shafts as nearly alike as possible, especially with regard to the angles of the various eccentrics, and also at as low a cost as possible. With these ends in view we designed the jigs and fixtures shown. Your readers will understand the importance of the eccentric and crank-pin angles being properly located; these fixtures prevent the possibility of error in this direction. With these fixtures the various centers were located once only, in place of the half-dozen times which would have been necessary under the old conditions.

The fixture shown at *A*, Fig. 6, was used as a jig to obtain the proper length of the portion forming the cranks and eccentrics, and also to enable the two holes to be drilled as shown at *B B*, Fig. 5. This jig was made of gray iron, bored at the ends 2½ inches diameter, as shown. Each end was faced up while still in position on the horizontal boring machine, and the inside faces machined 21 inches apart. The jig was afterward planed out at each end into the 2½-inch bore, to enable it to be slid into its place on the shafts and secured in position with the gray-iron clamps and swing-bolts shown.

Two round gray-iron plates were machined to the sizes given at *B B*, Fig. 6. On these plates the cranks were marked out as shown at *C C*, Fig. 6; the holes *D D* were also located and drilled. (These holes were properly located for the slotter tool to work into when cutting out the pieces to form the balanced cranks.) After being drilled, the plates were secured in position, one at each end of the fixture *A*, Fig. 6, care being taken that the plates were quite down in the 2½-inch diameter bored part at each end of the fixture *A*. This fixture was mounted on the surface plate, and plates *B B* were moved until the center of the low-pressure crank was vertical and the center of the high-pressure crank horizontal. The plates *B B* being secured in this position, the holes were drilled through the ends of *A*, using the plates *B B* as jigs; the fixture being finished and ready to answer as the jig for drilling the holes *BB*, Fig. 5. It will be noticed that the plates *B B*, Fig. 6, were in position on fixture *A* with the sides—on which the cranks were marked—outside. These plates were marked to their own ends and the center lines of the cranks continued across their edges. Sleeves *A A*, Fig. 5, were made from gray iron, bored 2¼ inches diameter, and the ends faced, the inner end being chamfered to allow for the fillet in the shaft and the other end turned with the projection—shown—on to which the mild-steel caps *E E* were fitted. Each sleeve was mounted on a surface plate. The center lines of the high-pressure crank on the short sleeve, and the low-pressure crank on the long sleeve, were accurately marked, and also marked across the diameter of the eccentrics which would be used in turning up the cranks. The eccentrics in the castings were 9 inches diameter, and correctly located with regard to their positions one with the other when making the patterns. Plates *B B*, Fig. 6, were now put in position at the eccentric ends of sleeves *A A*, Fig. 5, with the marked faces bolted down and moved around until the center of the cranks on plates *B B* coincided with the centers marked on the eccentrics on the sleeves *A A*. The holes *B B* in the sleeves *A A*, Fig. 5, were drilled and fitted with steady-pins driven into position. Plates *B B*, Fig. 6, having now fulfilled their purpose, were of no further use. Each sleeve *A A*, Fig. 5, was fitted with caps made of mild steel, the one on the short sleeve being fitted with three screws and a steady-pin; that on the long sleeve being fitted with two screws and a steady-pin, to prevent their being interchangeable. These caps were recessed on the inside, as shown, to clear the nuts. The sleeves were mounted on a shaft, turned as shown in Fig. 2, in which the steady-pin holes had been previously drilled in position by the use of the jig, Fig. 6; the sleeves secured in position by the nuts, the caps secured, and the whole mounted on the surface plate with the center of one of the cranks vertical and the other horizontal. The centers of the various eccentrics were accurately located on the caps *E E* by means of protractors, the caps being then removed, drilled with a small hole to form the clearance for the center end and the centers carefully countersunk.

In the tail center we ground a small V from the point, which allowed the center to be well lubricated. The caps were replaced, the shaft and fixtures placed in the lathe and each eccentric turned and polished to size. During the turning of each pair of eccentrics care was taken to properly balance the shaft, to insure the eccentrics being round, as on their correctness depends the accuracy of the finished eccentrics and crank pins of the crank shaft. It will be noticed that the high-pressure crank eccentric on the long sleeve was furthest away from the part of shaft which would form the high-pressure crank and on the short sleeve was nearest. This gives as much room as possible for the movement of the carriage

and also makes the distance between the two steady rests the same in all cases. Two steady rests as shown in Fig. 7 were prepared, planed to suit the bed, and bolted down, but not tightly. They were bored in their places and were moved forward by the carriage past the cutter, in a boring bar carried between the centers. They were bored to suit the eccentrics on the sleeves *A A*, and three gun-metal blocks fitted to take up the wear. These were found unnecessary, as the bearing being kept well lubricated wore very little. All being now ready for turning the various eccentrics and crank pins, a start was made on the low-pressure crank which is furthest away from the headstock and this was roughed out. The eccentrics were then roughed out, always moving on toward the headstock. This kept up the strength of the shaft for driving the

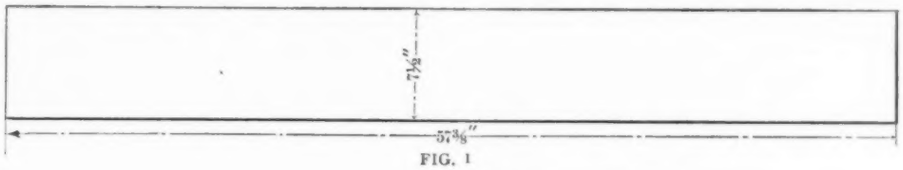


FIG. 1

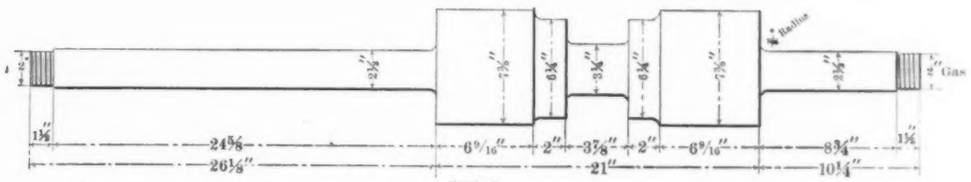


FIG. 2

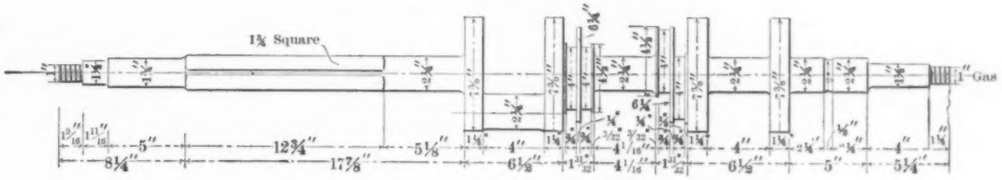


FIG. 3

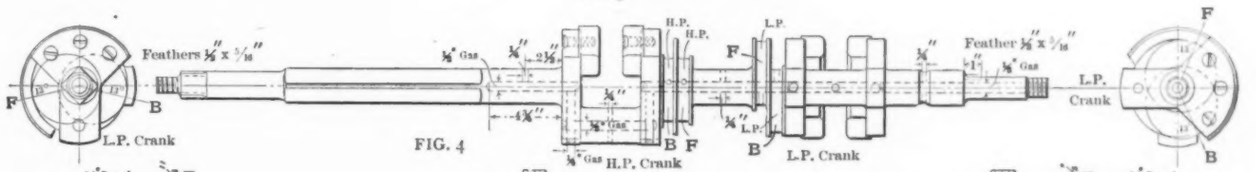


FIG. 4

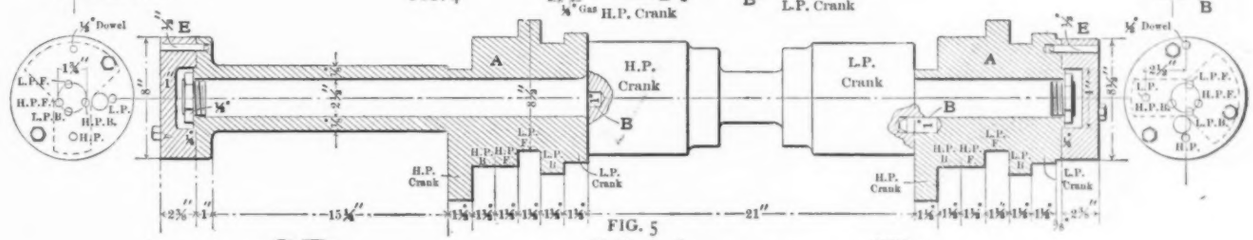


FIG. 5

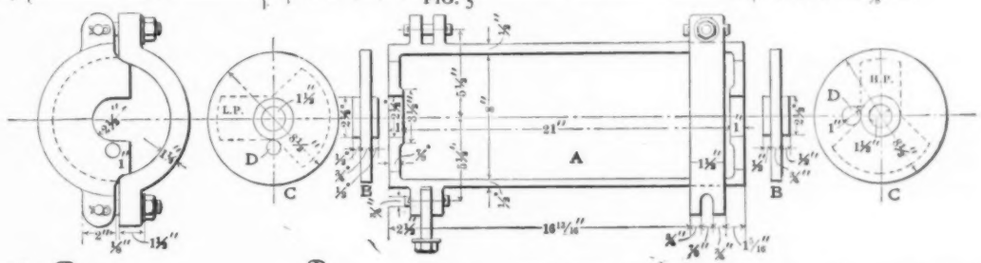


FIG. 6 THE MOTOR CRANKSHAFT AND THE JIGS AND FIXTURES.

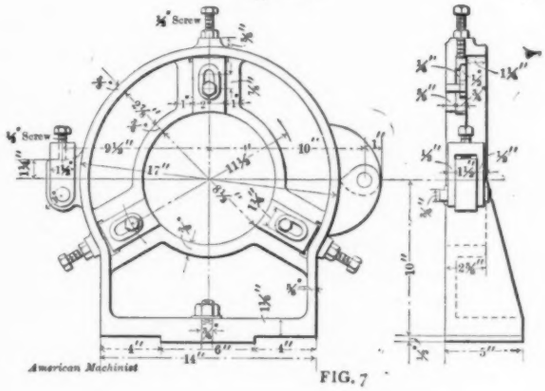


FIG. 7

heavy cuts used in roughing. The cuts, although heavy for this class of work, would not be considered heavy on ordinary work. After roughing out all the eccentrics and cranks, the *L P* crank and the others were then finished in rotation. The sleeves were then removed from the finished shaft and placed on the next shaft, the turning proceeded as before. The shafts had previously been centered and made to the correct length as a first operation and afterwards turned as shown in Fig. 2, with the width of the

part forming the cranks made to the jig *A*, Fig. 6, the ends smooth turned to standard gage and the parts 7⅜ inches diameter smooth turned. After the cranks and eccentrics were finished in all the shafts to the sizes given in Fig. 3, the ends were turned and finished as shown in Fig. 3, the holes drilled for the balance weights, the holes already used as steady-pin holes drilled through both cheeks and the second holes drilled through both cheeks. The shafts were then placed in the slotter and the slotting tool worked into these holes, cutting out the unnecessary pieces, making the cranks balanced shape as shown. The balance weights were of gray iron, machined on a profiler, where they fitted the crank sheets and were secured by screws; all were riveted in position to prevent them coming loose. The holes shown dotted in Fig. 4 were for oiling the various bearings, eccentrics and crank pins. The oil was forced in at one bearing at about 80 pounds pressure and passed through all the bearings. All parts of the engine were lubricated from the crankshaft by making the connecting rods, etc., hollow, and the oil pressure at the end bearing, after lubricating all the engine, was about 30 pounds; which was considered very good, having lost only 50 pounds in doing its work. These shafts worked up to 700 revolutions per minute. Possibly this may be of use to some reader of the AMERICAN MACHINIST who has such work in hand, or it may lead to further developments in turning such shafts. H. B.

Shipley, Yorks, England.

Peculiar Action of a High-Speed Steel Tool—Experience With Drills and Taps.

Mr. Huling, in an article at page 92, Part II, describes a peculiarity of high-speed steel under certain conditions. I remember experimenting with such tools as taps and twist drills made from a very satisfactory brand of this steel. The preliminary tests were made with twist drills, the size being ⅝ inch and the material drilled unannealed tool steel. At first the drills were heated to the high temperature necessary and quenched in oil. The hardness was reduced in order to overcome danger of breaking from extreme brittleness when the drill was under strain; in other words, the temper was drawn to a brown color.

This method, while the drills did fairly good work, did not give the results expected.

Acting on the results of experiments of others, we next hardened a drill and "drew the temper" until it was quite soft, when we attempted to use this, running at about the same rate as when using a similar tool made from "carbon" steel. It would cut but a little before the edge would turn over. Knowing by experience that this peculiar steel grew harder as it was heated, we ground the drill, heated it to a blue and immediately started drilling with it, with excellent results; then by increasing the speed, so it would remain in a heated condition while working, we had the satisfaction of drilling quite a number of holes in the block mentioned without apparently dulling the drill.

I have known taps which, on account of their being slender, were softened considerably after hardening, and which stood up fine when run at *high* speeds; but they were not in it with taps made from carbon steel when run at the *same* speeds. I do not mean to say that the above holds good under all conditions, but under the conditions mentioned the results were as described.

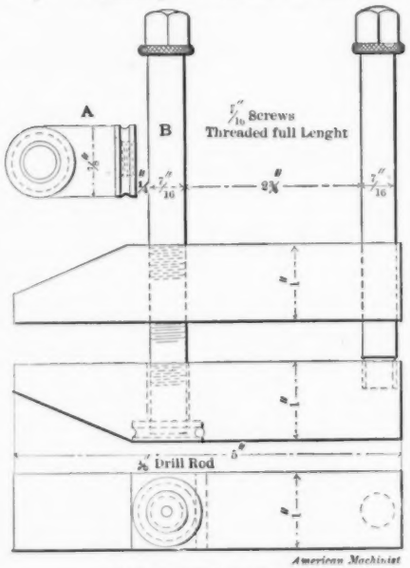
It seems to be a peculiarity of this steel that, unlike carbon steel, it grows harder as it is heated, until we reach a certain limit, when it becomes soft.

One who experiments very much with the high-speed steels has some very interesting experiences, and finds questions constantly presenting themselves which are hard to answer, as the results of today's experiments with one make of this steel do not tally with yesterday's results from another make.

E. R. MARKHAM.

Machinists' Clamps.

Being frequently troubled by the drill chuck interfering with the screws of the ordinary machinists' clamps, I made a pair as shown. The drawing is sufficiently clear, so that little explanation is necessary. In making the washer *A*, the 7-16-inch tap is run only part way through so it will screw tightly onto the end of the clamp screw *B*. The screw *B* is put through both jaws, screwed into the washer till the end comes flush, then riveted—the center in the end of the screw making this easy. They are made of C. R. steel throughout and case-hardened. They are not quite as quickly adjusted as clamps made in the ordinary way, but their convenience more than compensates.

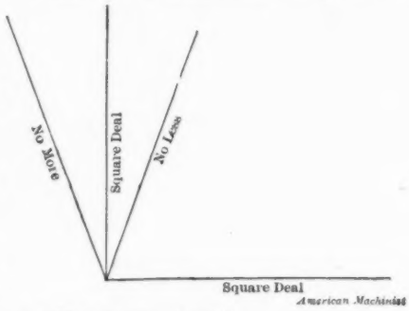


MACHINISTS' CLAMPS.

HANDYMAN.

The Square Deal.

I send you a draftsman's interpretation



of "The Square Deal."

C. F. EMERSON.

Patenting a Washing Machine Detail.

Not long ago I was in the city of Washington and spent some time in the search and reference room of the Patent Office, and while there seated at a desk looking over some copies of patents on machine tools, I heard some one remark: "Well, I will tell you what I will do: I will make you a nice drawing of the complete machine, and get you a patent on the legs of the machine, then you can take the patent before the people, and say 'there is my patent' and show them the drawing of the machine; not one in ten knows what a patent claim is." On looking up I saw that the speaker was a patent attorney, who with his client was seated near me and, I suppose, looking over references on washing machines, and in looking them over the attorney must have found that his client's idea, which evidently related to mechanism for beating and rubbing the fabrics within the machine, was already patented, and this led him to think of getting a patent on the legs.

The attorney was smiling and his expression seemed to say: "Now I have told you a good way to get a patent on that washing machine; how about it?"

His client looked surprised over what the attorney said about getting a patent on the legs of the machine—a part of the machine which he did not seem to care about; he evidently wanted a patent on a machine to wash fabrics and did not seem to care whether it had legs or not. Maybe he was thinking that it could be placed on a bench when in use, and when not in use it could be placed under the bench out of the way. No doubt his attorney will get him a patent on the legs. Possibly he showed the attorney a carelessly drawn sketch of the machine, and the attorney may have noticed that the legs were of unequal length and thickness, of an odd form or odd fastening, and he

probably thought that he could get a patent on them, and when the patent is granted with the title of washing machine along with the drawing of the machine, one would think he had a patent on a washing machine instead of on a few sticks underneath it. C. W. J.

[It is of course a fact that the mere marking of a machine "patented" means practically nothing by itself. He who wishes to know just what is patented about the machine and what the probable value of the patent may be must look much deeper than that.—ED.]

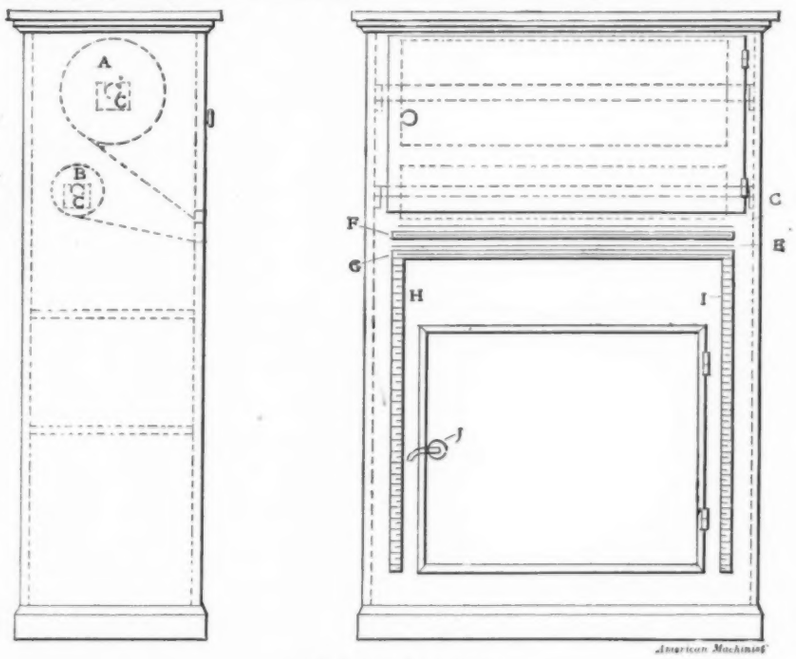
Drawing-Room Cabinet.

This cabinet for drawing paper, tracing cloth and other drafting supplies will prove a useful piece of furniture for the drafting room.

In the end elevation *A* is the drawing paper and *B* the tracing cloth, both supported at each end by brackets *C*, which are secured to the inside of the cabinet. The two compartments below are for storing all other supplies.

D and *E* in the front elevation are slots cut through the front of the cabinet to admit the paper and tracing cloth. *F* and *G* are metal plates, set flush with the front and also slotted. *H* and *I* are measuring rules, also flush with the front, *H* measuring from the slot in plate *F*, and *I* from the slot in plate *G*.

When a sheet of paper is wanted, it is pulled out from slot *D* along the rule *H* to the required length, and a knife blade

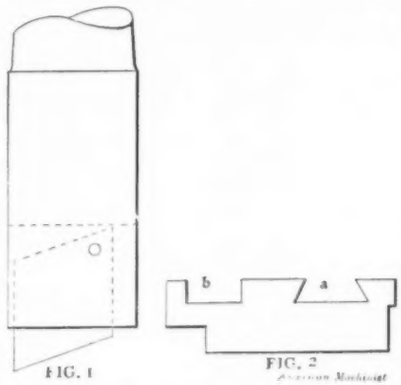


DRAWING-ROOM CABINET.

is inserted in the end of the slot in plate *F* and drawn over the paper, cutting it off square and to the desired length. Tracing cloth is cut in a similar manner, using slot *E*, rule *I* and plate *G*. Slots *D* and *E* are made to fit the paper and cloth neatly enough to cause sufficient friction to hold the end in place. Drawing the paper down over the edge of the slots will straighten it. *J* is not a knob, but an opening to operate the latch, thus doing away with all projections that would interfere with the measurement of the paper or cloth. The upper door is used only to put in new rolls. L. F. B.

Tool for Countersinking the Bottom of a Hole.

I send herewith a sketch of a tool for boring an inverted countersunk hole,



THE TOOL AND THE WORK.

which though doubtless not new may be of interest to some of your readers. The tool was made for boring holes in gray-iron bull-rings for a 36-inch engine piston; the holes being filled with plugs of anti-friction metal which were peened in and then turned down to within ⅛ inch of the diameter of the rings. The tool worked to perfection and made a much better job than could be had by coring the holes in the casting. Fig. 1 is a view of the tool complete, it consists of a holder made of tool steel, slotted at the lower end to receive a cutter which swings on a pin at the upper right-hand corner. The bottom edge of the cutter is ground rounding so as not to cut, and as the tool is fed down into the hole the cutter swings, making the hole the shape shown in Fig. 2, which shows a section of the bull-ring, the hole at *a* being finished, it having first been spotted with a twist drill and then drilled to the proper depth with a bottoming drill as at *b*.

The end of the holder should be a working fit in the small diameter of the hole and should be hardened to prevent wear. With this tool several hundred holes were drilled, the small diameter being 1½ inches, the large diameter, 1¾ inches, depth, 7-16 inch. An air blast was used to blow away the cuttings during the last operation. JOS. SEAMAN.

Some Questions in Connection With Tool Design.

I enclose a few questions on tool design that may seem quite simple to the man behind the machine, and it is hoped that future editions of the machines in question may make such inquiries unnecessary.

The "Woodruff" key is all right in its place, but why use it on lathe change gears? We have lathes built by a first-class manufacturer, and this is the only serious defect (there are minor faults); of course there is a speed box, and gears are not changed often; but when you do change, the keyway must be turned up, or the key drops in the scrap or on the floor. Sometimes a green hand omits it, and a tap or thread is spoiled.

Change gears for lathes should always have a fixed key in the shaft ⅛ inch shorter than the thickness of the gear wheel, then you can slip the gear on the end of the shaft, turn it till key enters, and have no trouble.

Why are lathe tailstocks left with such a short overhang, making it necessary for us to run the spindle out till it is springy in order to let the carriage back? Lathes for tool work should have a long overhang on the tailstock; so many jobs require it.

Why are hand-wheels on tailstocks left unbalanced? On light work it is often desirable to leave the spindle unclamped.

Why is the same defect on the cross-feed hand-wheel of a first-class surface grinder? In this case the weight of the handle permits the feed ratchet to pull it back a notch or two on the up turn of the heavy side.

Why does one of the best makers of milling machines require us to use a half-dozen different size wrenches for adjusting clamps, stops, arbor nuts, etc.?

Of course there is a wrench key-board, and some men always put the wrenches back in place; but it requires a lot of time

and practice to become automatically familiar with the size and location of heads and wrenches. This is not a minor fault, for it means inconvenience and lost time.

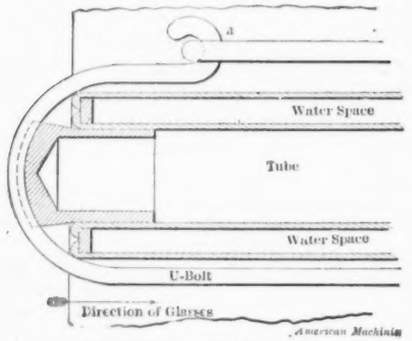
We have a machine built by a rival firm, and though not so high a standard, it is invariably preferred by the men, because it is handy; only two wrenches are used.

Standard screws with standard heads are all right in general, but an intelligent departure from standards in this respect would very much improve a standard machine.

A. B. C.

Plugging a Leaky Tube in a Marine Boiler.

Referring to Dixie's letter at page 57, Vol. 28, Part II, there may be instances in legitimate boiler practice when a tube should be plugged. In that case, I suggest a U-bolt as in the blueprint herewith. If the tubes are too long to admit the bolt, it may be hooked together, as at *a*, clamps being used at the rear end of the boiler, as Dixie has shown.



PLUGGING A LEAKY TUBE.

AMOS PRICE.

Making a Molder.

The suggestions of H. M. Lane, reported at page 130, Part II, call to mind a scheme which was once entertained by me. It is easy to forget the necessary shop-expense item and to consider that if we get labor for nothing, therefore the work produced costs us nothing.

Suppose we have some work which is a fair four-hours' job for a journeyman, whom we pay 25 cents per hour, and that our running expense amounts to 25 cents per hour more; then we have a total cost of $2—$1 for labor and $1 for expense. Now, suppose that we have an apprentice who is willing to work for nothing. It still costs us 25 cents per hour to keep the shop running; so it does not take long to see that if he takes 8 hours to do this job, it is costing us $2 again, though he gets nothing for it. If he takes longer than this, he becomes a pretty expensive man.

There is not much use trying to hustle these boys along; they will purposely block any effort. It seems to be their idea that, while they wish to learn how to do all these things, the time they consume ought not to enter into the consideration at all. It is this tendency which I believe must be done away with before any satisfactory solution of the apprenticeship problem, either in the shop or in a trade school, is possible.

Now, let us offer our nothing-an-hour boy a premium of, say, 20 cents per hour on all time saved under 8 hours or double the journeyman time. Then we may expect results as follows:

	Time.	Rate.	Labor Cost.	Premium.	Expense.	Total.
Journeyman	4 h.	25c.	$1.00	0	$1.00	$2.00
Apprentice	8 h.	0	0	0	2.00	2.00
"	7 h.	0	0	.20	1.75	1.95
"	6 h.	0	0	.40	1.50	1.90
"	5 h.	0	0	.60	1.25	1.85
"	4 h.	0	0	.80	1.00	1.80

From which it will be seen that our total costs may be made to decrease at the same time that our "nothing-an-hour" man begins to earn his way. If he does as well as the journeyman, he receives only 80 per cent. as much, which is fair, because he is under instruction, which costs us something. In fact, for a trade school this premium rate would probably be too high. It seems to me that this would be better than to handle the boys as Mr. Lane suggests, for the deferred premium would look a long way off; so far, in fact, that it would be likely to lose its effect. In fact, I doubt if the courts would uphold the withholding of this premium, unless it was clearly to be shown that the boy's leaving was through some very decided fault of his own. Most of the boys who wish to learn a trade are absolutely obliged to earn a living as they go along. Many come from families to whom it is a burden, and a tremendous one, too, to carry their children past the age of compulsory schooling. Many of the boys have no one to lean on at all, and some have others leaning on them. They need every cent they earn when they earn it. These boys do not usually have as great possibilities ahead of them as those reared in more comfortable circumstances, but they are the raw material from which we must recruit our machinists, unless we depend on foreign countries to make them for us.

If shop expenses were lower, as in some commercial shops, the time which an apprentice could use on a job could be increased, as shown below, where I have shown what could be done with the same job where the expense rate was only 12½ cents per hour, and where the premium rate is cut to 10 cents per hour.

	Time.	Rate.	Labor Cost.	Premium.	Expense.	Total.
Journeyman	4 h.	25c.	$1.00	0	$0.50	$1.50
Apprentice	12 h.	0	0	0	1.50	1.50
"	10 h.	0	0	.20	1.25	1.45
"	8 h.	0	0	.40	1.00	1.40
"	6 h.	0	0	.60	.75	1.35
"	4 h.	0	0	.80	.50	1.30

It is easily to be seen that both apprentice and shop are to be gainers by reduced time on the part of the boy.

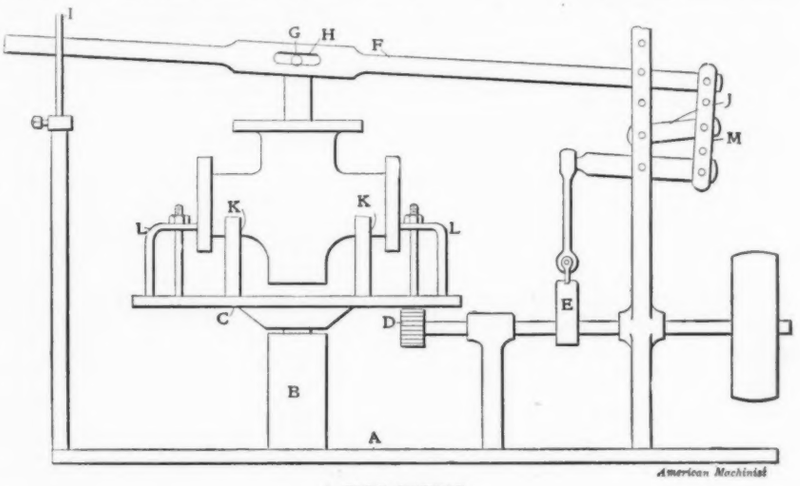
E. H. FISH.

Worcester Polytechnic Institute.

A Cock Grinder.

We use a great many stop cocks, ranging in size from the smallest to 8 inches. The cocks are of gray iron, this metal being found best adapted to the purpose. After being some time in use they leak, when it is necessary to refit them.

The plugs and bodies are first turned and bored in a lathe, the final fitting being done by grinding the plugs in, with emery and oil. The accompanying sketch shows a rig for grinding in the plugs of the large-size cocks. It consists of the base *A*, to which is attached the standard *B*, carrying the rotating table *C*, upon which the cock body is fastened. The table is rotated by means of the pinion *D*, meshing in teeth cast upon the under side of the table. Upon the pinion shaft is mounted the eccentric *E*, connected by levers with the bar *F*, the bar being attached to the shank of the cock plug by means of a collar set screwed to the square end. The



A COCK GRINDER.

collar has a lug or trunnion projecting from either side and passing through the slots *H* in the bar, the bar being made double, or as a yoke at this point. The other end of the bar, opposite the eccentric end, merely rests in the crotch of the adjustable standard *I*, the bar being prevented from moving laterally by means of the link *J*.

By this arrangement of lever and eccentric the plug is lifted from the body as the body revolves, thus keeping the abrasive evenly distributed and preventing scratching or scoring of the ground surfaces by too much of the abrasive acting in one place.

The rig is adjusted for different-sized cocks by means of a series of holes in the standard and link *M* and by moving the crotch *I* up or down in the gaspipe.

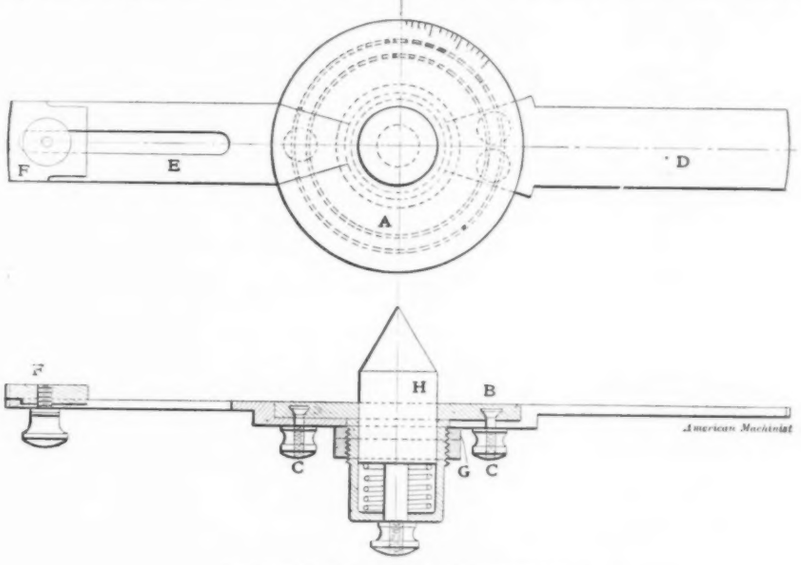
To inspect the progress of the grinding and to add new abrasive, the machine is stopped and the plug lifted by raising the end of the bar from the crotch.

The cock is held upon the table by means of the V-blocks *K* and the bolts and bent dogs *L*. GEO. WILSON.

Protractor for Laying Off Keyways.

Laying off the keyways in the ends of axles or engine shafts is not always the easiest job in the shop, especially when a very great degree of accuracy must be attained. I show by the accompanying sketch a protractor which was gotten up for laying off the keyways in locomotive axles, and which has proven a most satisfactory instrument. A dial *A* is graduated in degrees and a dovetailed groove *B* is cut in circular form in the outer surface to permit the lock bolts *C* to swing with and lock the revolving protractor blades *D* and *E*, which can be set at any degree desired by means of the graduations. Blade *E* is provided with a sliding, setting plug *F*, and after one keyway has been milled this plug is slipped down the slotted blade and locked in the finished keyway. Now the protractor is taken up and set to the proper angle, which the second keyway is to bear with relation to the finished one, and so on. The hub ends of the blades are held to a good bearing surface by means of the lock nuts *G*. To make sure that the instrument properly centers itself, a small spring is located back of the centering plug *H*. BAYARD.

San Francisco.



PROTRACTOR FOR LAYING OFF KEYWAYS.

Reducing the Thickness of Long Keys.

A short time ago I had occasion to thin down some long keys to about one-half their original thickness. These keys were about 36 inches long by 1½ inches square, and were to be reduced to a thickness of ¾ inch. They were made from finished keystock and intended to be used without machining, but a change in design necessitated the thinning to half the original thickness. Now, anyone who has ever tried to machine this stock is aware of its pure cussedness as regards keeping its shape. Perhaps it might interest some to know how we managed. First we tried the planer, but with very poor success. After the chip was run across and the wedges removed the key curled up like a bow, and it also had a bad wind in it. Then we tried it on a horizontal miller with no better success and finally we used a Becker-Brainard vertical milling machine, with an inserted tooth cutter. This cutter was run at a cutting speed of 125 feet per minute, with an 8-inch feed and a cut reduction of ⅛ inch. It required just thirty minutes to reduce one of these 36x1½-inch keys to the required thickness. Needless to say the chips came off a deep blue, but without damaging the cutter in the least, and the pieces came out practically straight. To get these results it was necessary to take one or two chips off the first side, after securely fastening to the table by means of a special clamping device, which gripped the work at four points. On letting up after this chip the work immediately curled up. Instead of trying to straighten it we simply turned the piece over on its milled surface, and took a chip off the back side. This removed the strain and allowed the first side to straighten, but leaving the second side convex. Then it was simply a matter of milling the key to size, as after the skin was removed from each side there was no more stretch. As we have milled a number of these pieces and they all acted alike, we came to the conclusion that the reason the planer failed was because the cut was lengthwise and removed one side before the other, thus allowing it to stretch sidewise as well as to curl up. The milling cut being square across, only allowed the work to curl, and this defect came out on the second cut. TEXAS.

Indicating Machinists' Dimensions on Drawings.

With reference to the discussion going on in the columns of your paper regarding dimensions on drawings, I offer the following: Make the original tracing with the machinist's dimensions only. From this make a print on "Vici" or a similar paper and put the patternmaker's dimensions on this. This makes very little more work than a tracing with all the dimensions thereon and gives a machinist just the dimensions he is to work to. Still another solution of the problem where it is inconvenient to make a black or brown print, is to make a blueprint and put the patternmaker's dimensions on this. This could be done very readily with a preparation similar to Soltmann's "Crystalline" ink, a 15-cent bottle of which will last an ordinary drafting room a year. Where time and expense in the drafting room are no object two tracings can be made, one for the machinist and one for the patternmaker. Quite frequently in my own office I make both a patternmaker's and machinist's drawing for intricate parts, such as the cylinder of a two-cycle engine

E. A. ROBERTS.

Indian Engineering, in referring to a report recently issued by the Director of Railway Construction on the working of certain American locomotives supplied to the North Western, Oudh and, Rohilkhand and Eastern Bengal State Railways, says: "The report on the American locomotives built by the Pittsburg Works for the Indian State Railways severely criticized the tires. But it turns out, and attention has been loudly drawn to the fact, that these tires were made of steel obtained from a well-known Leeds firm in England and were inspected before they were shipped to America."

The Transmission of Heat From Air to Water Through Corrugated Copper Tubes.

BY HARRY F. BENSON.

The necessity for the use of air coolers, with air compressors, is, of course, thoroughly appreciated. The economy gained by compounding is inappreciable, without inter-cooling. The heat loss in single-stage compressors may be 38%, but with inter-coolers and two-stage compressors this loss may be only 18%, in four-stage 8% and in practice even 5% or 3%. Jackets do practically no cooling. The after-cooler acts as an air drier by cooling the air, thereby causing the moisture to be precipitated, before sending the air into the system. It is evident that the correct design of the inter-cooler and after-cooler is an extremely important consideration.

It has been found that the rate of heat transmission between a hot medium and a colder one, at any instant, practically depends upon the difference of temperature existing between them at that instant. In general, heat is transmitted much faster from a very hot substance to one much colder, than between substances which have nearly the same temperatures. Fourier found that practically the rate of heat transfer is in simple proportion to excess of temperature, or that the quantity of heat units transmitted per degree difference of temperature, per unit of time, is a constant.

FORMULA FOR THE COOLING SURFACE.

For the purpose of finding the proper amount of surface, in a cooler for any given case, the following formula may be used:

$$A\,d\,U = K S_a\,(T_{a1} - T_{a2})$$

or
$$A = \frac{K S_a\,(T_{a1} - T_{a2})}{d\,U} \qquad (1)$$

where A = cooling surface in square feet.
K = pounds or air per hour.
S_a = specific heat of air.
T_{a1} = temperature of hot inlet air.
T_{a2} = temperature of cooled outlet air.
d = actual average difference of temperature between the air and the cooling water.
U = B. T. U.'s absorbed by the water, per degree difference of temperature, per square foot, per hour.

We have all the quantities in the above formula, except d and U, in any given problem. In the following discussion in regard to the determination of the value of d, it must be borne in mind that the cooler is so designed that the cooling water, and the air, travel in opposite directions; thus the cooling water entering meets the cooled air just going out, and the hot air entering meets the warm water leaving the cooler, making a contrary flow, and thereby maintaining the greatest average difference of temperature throughout. It is quite plain that we cannot take for d the arithmetical mean represented by

$$\frac{D_1 + D_2}{2}$$

where D_1 is the difference of temperature between air and water, where water enters, and D_2 is the difference of temperature where water leaves, because, as previously stated, the heat is transmitted much more slowly as the difference in temperature becomes less, or, the rate of heat transmission is a variable, making the rate of change in difference of temperature a variable, while the arithmetical mean represents the average of a *constant* rate of change of values.

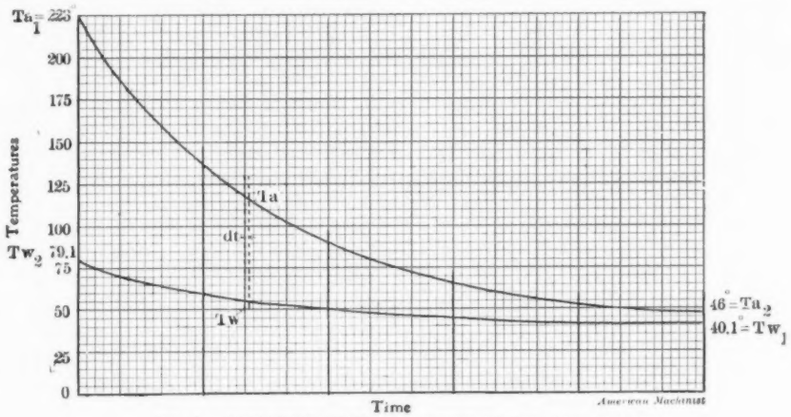


FIG. I. VARIATION OF TEMPERATURE OF AIR AND WATER.

THE MEAN DIFFERENCE OF TEMPERATURE.

For the purpose of obtaining the proper value of d, I have deduced the following mathematical solution, using the calculus:

Let
T_{a1} = temperature of hot inlet air.
T_{a2} = temperature of cooled outlet air.
T_{w1} = temperature of inlet cooling water.
T_{w2} = temperature of outlet cooling water.
h = heat units transmitted to the water, per degree difference of temperature, per unit of area, per second.
W = pounds of water per hour.
K = pounds of air per hour.
R = ratio of water to air $= \frac{W}{K}$
S_a = specific heat of air.
A = area of transmitting surface.

Figs. 1 and 2 have been plotted from values obtained in one of our experiments and show the variations in temperatures of the air and water throughout the cooler. T_a represents the temperature of the air at any instant, and T_w represents the corresponding temperature of the water at that same instant. Let the slight increases in temperature of the water during the time $d\,t$ be $d\,T_w$ then

$$d\,T_w = \frac{h\,A}{W}\,(T_a - T_w)\,d\,t \qquad (2)$$

$T_a - T_w$ represents the difference in temperature existing at this instant.

Putting the heat taken from the air, equal to the heat absorbed by the water,

$$W(T_w - T_{w1}) = K S_a\,(T_a - T_{a2})$$

whence

$$T_a = \frac{W}{K S_a}\,(T_w - T_{w1}) + T_{a2} \qquad (3)$$

which represents the relation between the two variables T_a and T_w. Substituting value of T_a, in equation (2):

$$d\,T_w = \frac{h\,A}{W} \times \left[\left(\frac{W}{K S_a} - 1\right) T_w - \frac{W}{K S_a}\,T_{w1} + T_{a2}\right] d\,t$$

and

$$\frac{d\,T_w}{\left(\frac{W}{K S_a} - 1\right) T_w - \frac{W}{K S_a}\,T_{w1} + T_{a2}} = \frac{h\,A}{W}\,d\,t$$

multiplying both members by $\frac{W}{K S_a} - 1$

$$\frac{\left(\frac{W}{K S_a} - 1\right) d\,T_w}{\left(\frac{W}{K S_a} - 1\right) T_w - \frac{W}{K S_a}\,T_{w1} + T_{a2}} = \frac{h\,A}{W}\left(\frac{W}{K S_a} - 1\right) d\,t$$

We now have a differential equation between the two variables T_w and t.

Integrating first member between T_{w1} and T_{w2} as inferior and superior limits, respectively, and second member between o and t_1, as inferior and superior limits, respectively,

$$\int_{T_{w1}}^{T_{w2}} \frac{\left(\frac{W}{K S_a} - 1\right) d\,T_w}{\left(\frac{W}{K S_a} - 1\right) T_w - \frac{W}{K S_a}\,T_{w1} + T_{a2}} = \int_o^{t_1} \frac{h\,A}{W}\left(\frac{W}{K S_a} - 1\right) d\,t$$

$$\log_e \left[\left(\frac{W}{K S_a} - 1\right) T_w - \frac{W}{K S_a}\,T_{w1} + T_{a2}\right] \Bigg|_{T_{w1}}^{T_{w2}} = \frac{h\,A}{W}\left(\frac{W}{K S_a} - 1\right) t \Bigg|_o^{t_1}$$

$$\log_e \frac{\left(\frac{W}{K S_a} - 1\right) T_{w2} - \frac{W}{K S_a}\,T_{w1} + T_{a2}}{T_{a2} - T_{w1}} = \frac{h\,A}{W}\left(\frac{W}{K S_a} - 1\right) t_1$$

$$\log_e \frac{\frac{W}{K S_a}\left(T_{w2} - T_{w1}\right) - T_{w2} + T_{a2}}{T_{a2} - T_{w1}}$$

$$= \frac{h\,A}{W}\left(\frac{W}{K\,S_a} - 1\right)t_1 \qquad (4)$$

Now, by equating expressions for heat taken by water and heat given up by air, we have

$$W(T_{w2} - T_{w1}) = K\,S_a\,(T_{a1} - T_{a2}) \qquad (5)$$

whence

$$\frac{W}{K\,S_a}\left(T_{w2} - T_{w1}\right) = T_{a1} - T_{a2}$$

Substituting in (4)

$$\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}} = \frac{h\,A}{W}\left(\frac{W}{K\,S_a} - 1\right)t_1$$

Now choosing our units so as to make h, the amount of heat units, in B. T. U.'s, transmitted per degree difference of temperature, per square foot, and the time t_1 per hour, we have

$$\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}} = \frac{A\,U}{W}\left(\frac{W}{K\,S_a} - 1\right)$$

$$= A\,U\left(\frac{W - K\,S_a}{K\,S_a\,W}\right)$$

$$A\,U = \frac{K\,S_a\,W}{W - K\,S_a}\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}}$$

$A\,U$ represents the quantity of heat transmitted, per degree difference of temperature, per hour; but the total heat transmitted per hour is

$$\text{then } A\,U\,d = W(T_{w2} - T_{w1})$$

$$d = \frac{A\,U\,d}{A\,U} = \frac{W(T_{w2} - T_{w1})}{\frac{K\,S_a\,W}{W - K\,S_a}\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}}}$$

$$= \frac{W - K\,S_a}{K\,S_a}\,\frac{(T_{w2} - T_{w1})}{\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}}}$$

$$d = \left(\frac{W}{K\,S_a} - 1\right)\frac{T_{w2} - T_{w1}}{\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}}}$$

$$\text{but } \frac{W}{K} = R$$

$$\text{then } d = \left(\frac{R}{S_a} - 1\right)\frac{T_{w2} - T_{w1}}{\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}}} \qquad (6)$$

$$\text{from (4) } \frac{W}{K\,S_a} = \frac{T_{a1} - T_{a2}}{T_{w2} - T_{w1}}$$

$$\text{or } \frac{R}{S_a} = \frac{T_{a1} - T_{a2}}{T_{w2} - T_{w1}} \qquad (7)$$

Substituting this in (6)

$$d = \frac{(T_{a1} - T_{a2}) - (T_{w2} - T_{w1})}{\log_e \frac{T_{a1} - T_{w2}}{T_{a2} - T_{w1}}} \qquad (8)$$

We have now two equations, (6) and (8), either of which may be used to find d. Equation (6) contains the expression $\frac{R}{S_a}$, while (8) is expressed entirely in temperatures.

In the formula for d it will be noticed that the term T_{w2}, the temperature of the outlet water, may be determined by the formula (7), whence

$$T_{w2} = \frac{S_a}{R}\left(T_{a1} - T_{a2}\right) + T_{w1} \qquad (9)$$

It is apparent that the more cooling water we use, thereby increasing ratio R, the lower is the temperature T_{w2}. Also the less T_{w2} is, the larger d becomes. But the greater this difference d, the less surface we need. I find, however, that after increasing the quantity of water and consequent values of R to a certain amount, the saving in surface secured by any further increase is insignificant. In Table 1 I give the results of a number of solutions of the same problem, giving the surface required for different values of R.

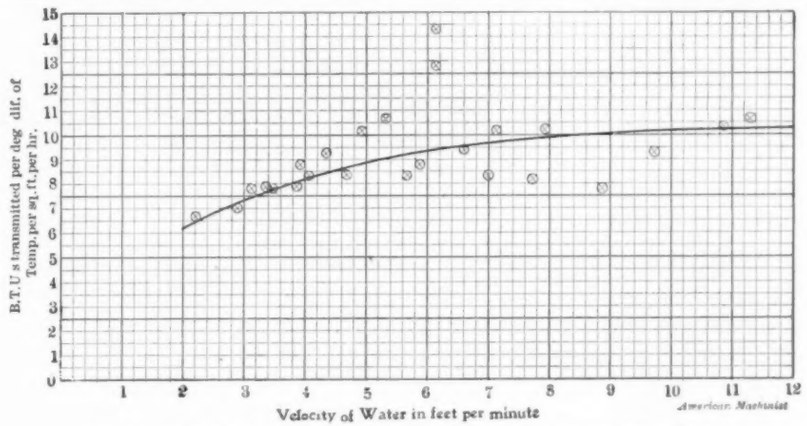


FIG. 2. RELATION OF HEAT TRANSMITTED AND VELOCITY OF WATER.

From these results, it appears that 10 is about the largest value of R, which it is economical to use, as there is a saving of less than ½ of 1 per cent. in increasing R from 10 to 15. It is even probable that, in many cases, when it is especially desirable to save water it will be advisable to make $R = 5$. With the value of R chosen, we can now solve for T_{w2} and also for d.

HEAT UNITS TRANSMITTED PER SQUARE FOOT OF SURFACE.

Referring to formula (1) we see that the value of U, or the heat units transmitted per degree of temperature, per square foot, per hour, remains to be determined. The heat conductivities of both air and water are very low as compared with the conductivity of copper. There is no difficulty in making the copper tube transmit all the heat given to it by the air, and all that the cooling water can remove. If all the heated particles of air and all the particles of cooling water can be made to come in contact with the transmitting surface the heat will be transmitted without depending upon conduction of heat in the air and water. This condition is secured by the stirring and breaking up of the air and water by some means. The Taunton Locomotive Manufacturing Company accomplishes this stirring and churning action by supplying its coolers with the corrugated tube. This company has found in heating water by steam, using the corrugated tube, that the stirring action is increased and, consequently, the transmission power, by increasing the velocity of the water; so do I find that this is true, also, in the case of air coolers. Then the value U will increase within certain limits, with the velocity of the cooling water.

R	T	d	A	Per Cent. Saving.
5	66.64	60.82	282.90	
10	63.32	61.71	278 82	1.44
15	62.22	61.98	277.60	.43
20	61.66	62.12	276.98	.32
25	61.50	62.17	276.75	.08
50	60.75	62.35	275.96	
100	60.375	62.46	275.56	

TABLE 1. REDUCTION OF SURFACE WITH INCREASED VELOCITY OF WATER.

No. of Exp.	Temperature of Inlet Air, T_{a1}.	Temperature of Outlet Air, T_{a2}.	Temperature of Inlet Water, T_{w1}.	Temp. of Outlet Water, T_{w2}.	Air in Lbs. per Min.	Water in Lbs. per Min.	B. T. U. from Air per Min.	B. T. U. to Water per Min.	Velocity of Water in Ft. per Min.	Value of U.
1	223.0	46.0	40.1	79.1	130.5	114 80	5484	4477	8.86	7.86
2	214.2	43.5	43.0	94.7	117.3	79.84	4753	4128	6.16	14.82
3	207.0	40.0	40.0	92.0	119.4	79.80	4734	4150	6 158	12.92
4	214.5	46.3	43.0	106.2	124.6	68.95	4976	4357	5.32	10.55
5	201.0	45.5	41.0	104.0	118.9	63.78	4391	4018	4.92	10.02
6	214.0	54.0	44.4	115.0	126.3	60.20	4799	4250	4.65	8.31
7	206.0	49.0	42.0	114.0	124.2	56.40	4629	4061	4.35	9.22
8	218.3	54.8	45.2	124.4	122.3	52.17	4748	4132	4.03	8.39
9	209.6	54.0	43.8	125.9	122.1	50.00	4511	4105	3.86	8.81
10	212 0	58.0	43.0	133.3	124.3	44.23	4544	3994	3.41	7.79
11	217.0	56.2	44.0	132.0	125.6	49.48	4796	3985	3 82	7.98
12	222.0	59.2	44.5	138.9	126.7	43 97	4900	5151	3.39	7.88
13	224.0	63.3	45.7	149.2	126.3	40.30	4819	4171	3.11	7.91
14	217.0	64.3	45.8	146.4	122.8	36.73	4452	3695	2.84	7.12
15	221.0	76.3	50.0	169.0	125.2	28 50	4303	3892	2.20	6 75
18	236 3	58.9	48.5	106.3	125.2	90,74	5276	5245	7.00	8.30
19	237.2	58.1	49.3	99.5	125.5	100.19	5336	5060	7.78	8.10
20	231.6	59.6	52.9	110.3	123.3	85.47	5034	4906	6.60	9.30
21	234.6	63.6	52.6	120.2	124.4	73.25	5051	4952	5.65	8 41
22	234.9	61.0	53.1	116.8	125.5	76.41	5182	4867	5.90	8.95
23	229.3	55.0	51.3	98.8	125.6	103.47	5197	4863	7.98	10.23
24	242.9	61.7	55.3	114.0	133.6	92.72	5649	5443	7.15	10.01
25	250.5	58.8	51.7	98.2	134.0	140.23	6099	6521	10.82	10.33
26	239 3	57.5	51.0	95.2	130,0	125.70	5612	5556	9.70	9.38
27	246 0	58.0	52.3	96.1	133.8	145.90	5977	6244	11.26	10.57

TABLE 2. VALUES OF U UNDER VARYING CONDITIONS.

I give in Table 2 the results of a large number of experiments made on a Wainwright air cooler, manufactured by the Taunton Locomotive Manufacturing Company and in use at the works of the American Waltham Watch Company, Waltham, Mass. I want to state my indebtedness to Mr. H. C. Eaton, of the American Waltham Watch Company, who has kindly supplied me with results from the use of the cooler at that plant.

I have computed the quantities by my formula, and the plotted curve, Fig. 2, will show the variation of U with the velocity.

It is said that a searchlight of 316,000,000 candle power has been built at Berlin for the Russian Government. It needs it.

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The "Bennington" Disaster.

For those who are at all acquainted with boilers and their care, the simple story of what occurred on board the "Bennington," as set forth in the report of the Court of Inquiry, gives all the information they need, except the important point of how conditions, such as described, could possibly be present in any navy worthy of the name.

The officer in charge of the engines—a young line officer—had been informed, orally, that the safety valves had been overhauled in March and that they were in working condition. There is no report in writing that this work was done, and there is no satisfactory evidence that it actually was done. The apparatus for raising the safety valve from its seat by hand was shown not to have been in working order, and probably was not used when raising steam. When five pounds of steam showed in the gage an oiler told a fireman to go above the boiler and close an air cock. The fireman probably supposed he had done that, but instead he closed a cock in the pipe leading to the steam gage; thereupon the pressure indicated by the gage fell to zero and the firing went on. Two similar boilers were being fired strongly; the gage on one of them showed a pressure of 145 pounds; the other, fired in the same manner, showed no pressure upon its gage. The firing continued; leaks developed, due to the excessive pressure; the firing continued; suddenly the boiler let go, the boiler-room and engine-room were wrecked, and a greater number of lives were destroyed than were lost by the navy in the Spanish war.

The tale is a very simple one, but while one might expect that the steam-engine department of a frontier sawmill might possibly be managed in that manner, it is well-nigh inconceivable that such a thing could be possible in any navy, and would have been unbelievable had not this official report set forth the facts as pertaining to the navy of a nation which prides itself upon its mechanical and engineering knowledge. The occurrence is a burning shame and disgrace, and if it does not lead to a complete reorganization of the steam-engineering corps of the navy, then it is as certain as anything can well be that, should our navy be put to the test of war, it will fail by the failure of its engineer department.

Any intelligent group of boys from 12 to 15 years of age, who had been around a steam plant and had opportunity of observing the procedure followed in raising steam in boilers, might reasonably have been expected to have done better than was done in this case. In fact, what took place seems incompatible with the full possession and command of their faculties by the men concerned, and we are impelled to question if they were sober. It seems almost impossible that men, duly sober, should have conducted themselves in the way in which they did. It is the first impulse of those who have had even a limited experience with boilers to continuously and carefully examine gages, and where gages act in any way erratically or different from what they may be expected to act, it is second nature to immediately ascertain why they act in that manner. It is pretty nearly inconceivable that sober men, knowing even the simplest elementary facts about boilers, could go ahead and fire strongly under a boiler, the steam gage of which refuses to show any pressure; to keep on such firing until leaks develop, and then go on beyond that until the boiler gives way from sheer inability to stand the excessive pressure.

It is evident, also, that the safety valve was not lifted from its seat at the beginning of the rise of the pressure. Such lifting of the safety valve is one of the elementary precautions that are always taken in every well-regulated boiler-room. It has been established by abundance of experience that it is the only way of being assured that safety valves are in working order and that they will open when the limiting pressure has been reached. In short, every well-known and familiar rule of precaution regarding the firing of and the raising of steam in boilers seems to have been utterly disregarded in this case. Three of the men who were immediately responsible, in the sense that they should have known better, lost their lives in the inevitable explosion. The one who is said to have been mainly responsible still lives and is to be tried by court martial. It will be well if this court martial, or a Congressional committee of inquiry, or some other authority, goes further and ascertains why it was possible for the conditions described to be present upon any naval vessel of the United States. And until such things are made impossible it is simply absurd and ridiculous for Americans to plume themselves upon their navy and upon its supposed efficiency. So long as such things are at all possible, its boasted strength and efficiency are only on paper and are a sham and a delusion.

On some accounts it is to be regretted that it so seldom occurs that only one improvement is put upon a machine tool at one time. As a general thing, when any change of design is made, many changes are made at the same time, and the tool is then said to be made from "new patterns throughout." The result is that the effect of any one change is often obscured so that it cannot be accurately estimated or gaged.

Taking, for instance, the case of a new and modern planer, the cross rail of which, instead of being of the usual form, is made of rectangular cross section and extends back between the housings, a distance considerably more than equal to its depth, and upon the inside faces of the housings has a bearing to which it is

secured by bolts fitting in T-slots. In this way the tendency of the cross-rail to twist owing to the stress of the tool with its point below the cross-rail, is evidently very much lessened, and the torsional rigidity of the cross-rail immensely increased; but upon asking the man responsible for this design if he had made any tests to show just how much stiffer such a cross-rail was, he replied that no such tests had been made, and no such tests could conveniently be made, because there was no planer of the older type which could be tested in such a way as to make a fair comparison, other changes having been made at the same time, so that the increased stiffness due to this one feature could not be separated from the general result that might be obtained in such a test. Similar things occur all through the practice of machine-tool design. The designer starts out to make a given machine tool heavier and more rigid. He does this at every point where he can see a chance for improvement, and if the result satisfies him—if the tool, as a whole, is as much stiffer and more satisfactory than the older, as he desired it to be—he accepts the result as satisfactory; his customers do the same, and there is little opportunity for knowing definitely just how much of good results from any particular feature of the improved design.

Electric Railway Engineering at Worcester Polytechnic Institute.

A Chair in Electric Railway Engineering has been established at the Worcester Polytechnic Institute, and definite instruction in that branch of engineering is to be given during the coming year. Albert Sutton Richey, chief engineer of the Indiana Union Traction Company, has been appointed Assistant Professor of Electrical Railway Engineering. Mr. Richey is a graduate from the course in electrical engineering of Purdue University of the class of 1894, and since the time of his graduation he has been constantly engaged in practical electrical work. For the past few years he has been connected with the Indiana Union Traction Company, and a few months ago he was made chief engineer of the road. This company operates the largest interurban electric railway system in the world, operating with high potential transmission circuits from a single power station. The system comprises about 400 miles of track; and a part of their transmission system is operated at 15,000 volts, and a part at 30,000 volts. This road is one of the pioneers in this country in operating high-speed express, freight and sleeping-car service.

Arrangements are being made for a competitive exhibition in Germany, in October next, of freight and omnibus automobiles, to which foreign autos will be admitted.

New Tools and Machine Shop Appliances.

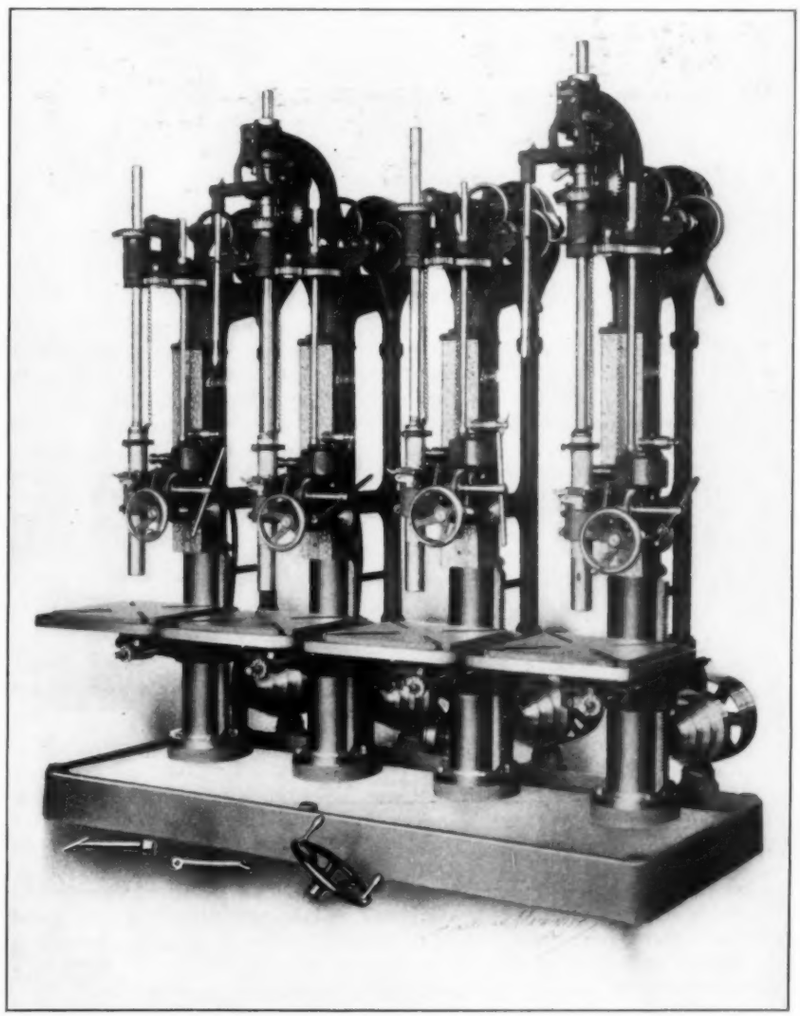
THE GANTT FURNACE.

THE GANTT FURNACE.

The half-tone illustrates a new furnace for handling high-speed and ordinary steels, small drop forgings, rivets, etc. The furnace uses either coal or coke. The wind box is at *A;* the fuel reservoir, for feeding the fire automatically, at *B;* the cranks for operating the grates at *C*. The small opening *D* at the side is for treating high-speed steel, the larger opening *E* in front being for general work. The heat is confined in the furnace and no flue or chimney is necessary. Three sizes are made, the smallest having a 9x2½ heating chamber and the largest a chamber 24x5 inches. A. P. Witteman & Co., 233 Cherry street, Philadelphia, Pa., are the makers.

GANG DRILL.

The illustration shows a special arrangement of drills just completed for the Cincinnati Milling Machine Company by the Cincinnati Machine Tool Company. The combination consists of four 24-inch drills with positive geared feed, two of the ma-



GANG DRILL.

chines being standard drills and two being fitted with geared tapping attachments, and all mounted on one large base. The drills are equipped with square oil grooved tables and an oil pump for supplying the lubricant and are arranged for piping to suit the particular requirements of the shop in which they are placed. The raising and lowering device for the table differs slightly from the arrangement usually employed by this concern on its drills, being operated by means of a clutch and hand wheel from the front of the machine.

GAP LATHE FOR TRUING CAR AXLES.

The illustration, Fig. 1, is of a 22-inch gap lathe, especially adapted for steam and street railroads for truing car axles when the car wheels are in place; thus saving the time of forcing the wheels off before truing the axles and then forcing them on again, as is usually done when truing car axles. This lathe swings 22 inches over the ways, and a standard car axle with wheels in place over the gap. It has a 13-foot bed, which takes 7 feet 8 inches between centers, and is furnished with a rod feed and plain block rest as shown. This lathe can also be made with a block to fill the gap, compound rest, lead screw and gears for screw-cutting, such as are shown in outline in Fig. 2, so that it can be used as a regular engine lathe when not being used for truing car axles. It is made by the Draper Machine Company, Worcester, Mass.

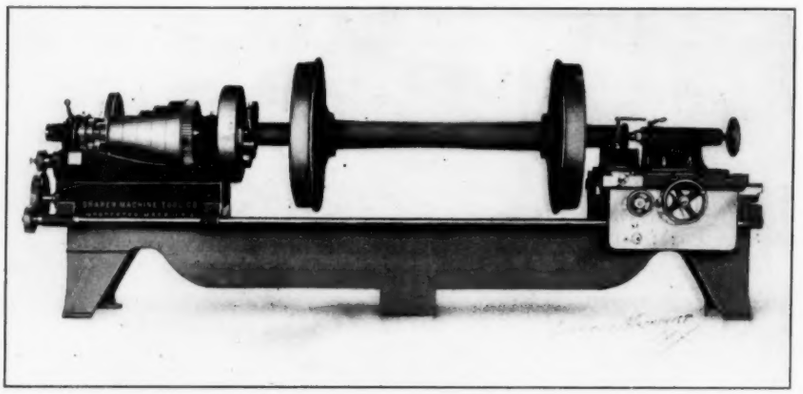


FIG. 1. GAP LATHE FOR CAR AXLES.

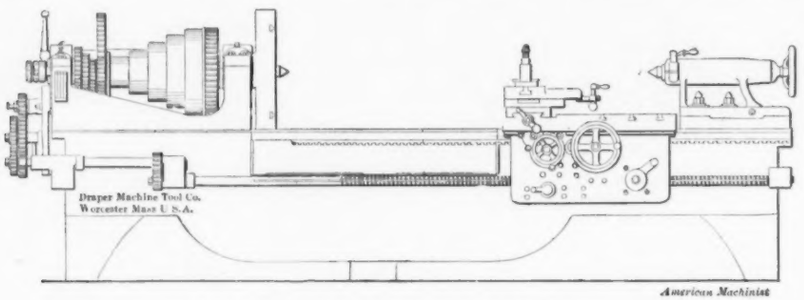


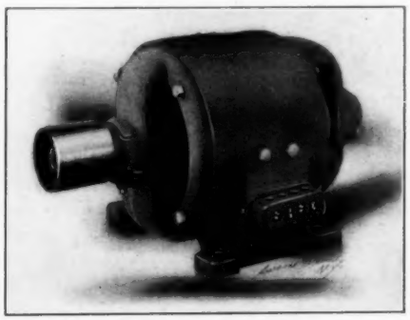
FIG. 2. GAP LATHE FOR CAR AXLES.

A NEW LINE OF SMALL MOTORS.

The accompanying illustration shows a new line of motors known as the "C Q" motors, which has just been brought out by the General Electric Company, in which have been incorporated those qualities which have been found necessary in motors for especially severe service. In particular the insulation of the armature is of high grade, being similar to that used in railway motors. A large surface of copper is provided in the position best suited to dissipate the heat. The standard motor will deliver its rated output with a rise in temperature of not over 45 degrees Cent. in any part above the surrounding air, while the motors will operate under a 25 per cent. overload for one hour, and a temporary overload of 40 per cent. may be carried without injurious heating.

The speeds have been chosen to permit direct belting to line shafts running at ordinary speeds without the use of intermediate countershaft, the use of steel magnet frames and of well-proportioned supports on the end bearings economizing material to an extent which gives a low weight per horse power even at moderate speeds. When larger than normal speed reductions are desired a belt-tightening apparatus is provided by which increased arc of contact is provided and the full power is transmitted with a small motor pulley, thus avoiding the use of a gear drive.

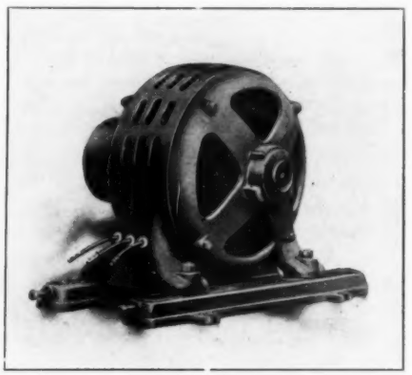
The bearings have ring oilers and may be rotated to four positions for attachment of the feet to the floor, ceiling or side wall. The motors are built in sizes from ¼ to 20 horse-power.



A NEW LINE OF SMALL MOTORS.

A NEW LINE OF INDUCTION MOTORS.

For some reason which is not very apparent induction motors seem to have made greater progress in Europe than in this country, although at present American manufacturers of electrical machinery are devoting much attention to this class of machines.



A NEW LINE OF INDUCTION MOTORS.

The illustration represents a line of such motors, ranging in capacity from 5 to 20 horse-power, which has just been brought out by the Commercial Electric Company, of Indianapolis, Ind., and in the design of which the manufacturers have arranged to avail themselves of European practice by engaging a European engineer of large experience in this field.

The mechanical construction of induction machines is so simple as to leave small opportunity for ingenuity in design, the efforts of the designer after securing good ventilation, large bearings and good workmanship, being directed toward electrical features in order to secure a high power factor, high efficiency, low temperatures, high starting torques, etc., all of which points have received due attention in the design of these machines.

The exports of copper during July from all ports in this country aggregate 18,478 tons, 227 tons being shipped from New Orleans and 1,038 tons from Seattle to China. During July, last year, the total exports were 19,490 tons.

A Sectional Cupola.

The difficulty in cleaning and repairing the lining of small cupolas has prevented their general use. In emergencies, such a cupola would be a very great convenience, if it could be easily managed.

The cupola shown in the accompanying half-tone is made in sections, 18 inches long and 28 inches outside diameter. These are lined with ordinary stock brick, laid flatwise, the edges being beveled to key the bricks in. The complete lining is 3 inches thick, making the inside diameter 22 inches. A ring of 1½-inch angle iron is riveted to both ends of each section for stiffness, to hold the brick in place and to make a joint between sections. The lower section contains a wind box and six tuyeres, 4½ inches square on the inside. This section is set on a solid bed-plate on wheels, so that the cupola can be rolled anywhere required. The sections can be handled by a light jib crane or by a trolley, placed a little to one side of the stack and fitted with an ordinary chain hoist.

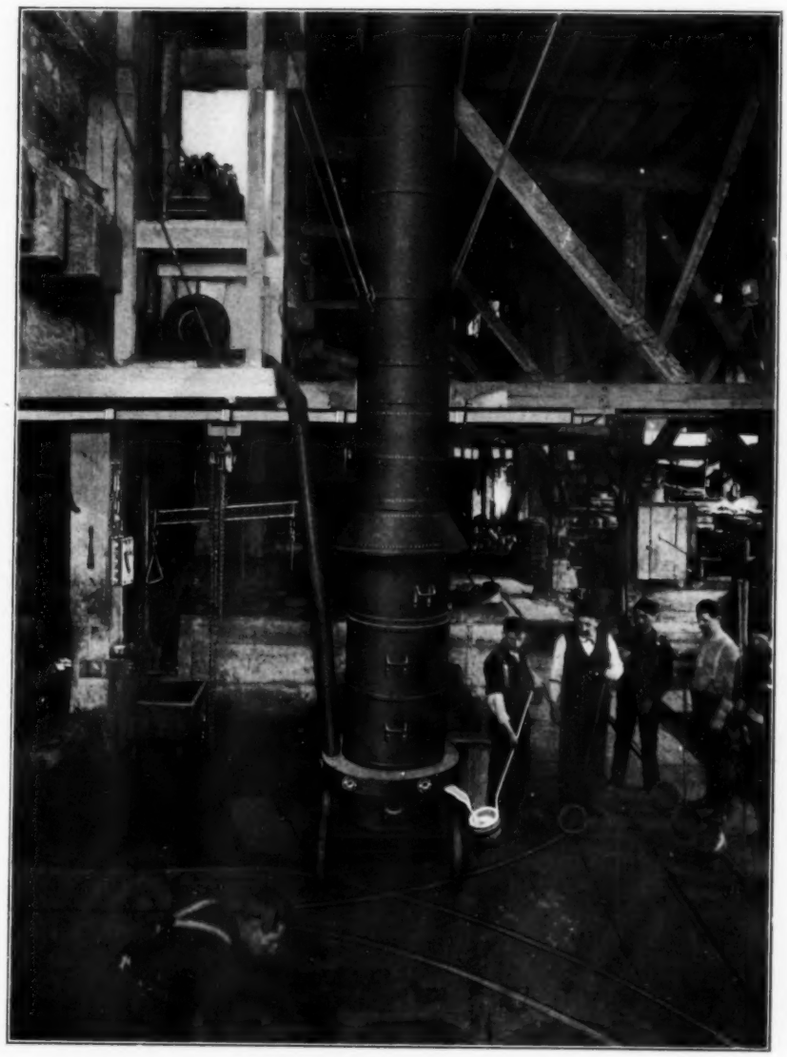


FIG. I. A SECTIONAL CUPOLA.

The stack is suspended by rods from the foundry roof, is 24 inches in diameter and flares at the lower end to 36 inches. The lower end is 7 feet 6 inches from the floor, and is just high enough for the cupola to roll under it. One side of the flaring portion is cut away for a charging door. The 3-inch opening between the top of the cupola and the edge of the stack creates a strong draft and keeps the air fresh around the cupola.

It is best to repair a lining before the heat is required so as to save delay when a heat is needed. To take off a heat the bed-plate is rolled under the trolley track, and the lower section put in place. The sand bottom, 2½ inches thick at the front and 3½ inches at the back, is put in, the spout lined, the breast put in and a slag hole made at the rear. Shavings and kindlings are placed in this section and the other three sections put in place, the joints being daubed on the inside.

Then the cupola is rolled under the stack and the pipe connected between the blower and the wind box. A charging platform may be made of boxes or flasks, and a charge of 100 pounds of coke put in, the fire being lighted two hours before iron is wanted. When this coke is well lighted the charge should be 60 pounds of coke and 200 pounds of iron; then 30 pounds of coke and 200 pounds of iron, and so on. The cupola holds four charges, which can be put in in 15 minutes.

The pig iron should be broken into pieces about 10 inches long and the scrap as small and evenly charged. If it is desired to hurry the fire in lighting, the wind pipe from the blower can be connected to the slag hole before it is connected to the wind box. The blast should be put on at the tuyeres 15 minutes before iron is wanted.

The cupola will melt 2,000 pounds of iron per hour and 18 charges, or 3,600 pounds, can be melted at one heat. Two or three heats may be made the same day. The blast can be delivered from a No. 2 Sturtevant fan driven by a 5-horse-power motor. It takes 4½ horsepower to drive the fan at 1,500 revolutions per minute. The following are some of the advantages:

A test charge of 100 pounds of iron will show the quality of any pig iron or mixture if the fire has burned two hours—that is, if the cupola is as hot as a large cupola. On days when from any cause the large cupolas are not run, the foreman and his assistants can mold and take off two or three heats, and during any shut-down repair castings can be made in a hurry. The iron may be ready to pour by the time a piece is molded. If any important piece is lost at the regular heat, it can be made the same night or early next morning. For special mixtures, such as white iron, chilling iron, semi-steel or soft iron for patterns, the results will always be as calculated. If molders break a heat, the cupola can be rolled in place and started before the men get out of the shop, and work that is needed can be made, so as to keep the rest of the shop running. As a result, very few heats are broken.

This cupola is the invention of W. J. Keep, and it is manufactured by the Northern Engineering Works, Detroit, Michigan.

Effects of War Upon Japan.

We have published several communications tending to show that Japanese commerce and industrial development go on during the war about as though there were no war. The *Daily Consular Trade Reports*, however, reprints from the *Birmingham* (England) *Mail* the following:

"Of late all the consular reports relating to ports and towns in Russia and Japan have recorded loss of trade because of the war, but our consul at Nagasaki, Mr. F. W. W. Playfair, has a still more doleful tale to relate of his district.

"Trade and Japanese and Russian shipping," he says, "have been seriously affected by the war, and this has not been made

good by the increase in British and Norwegian shipping. In the country districts, while the people apparently pursue their ordinary avocations as though no such thing as war existed, the Japanese business men of the open ports are 'hard hit' by the extra burdens of taxation consequent on the war expenditure and by the dislocation of Japanese shipping owing to the requisition of many transports. The war, too, has killed more than half of the usual tourist traffic of the last few years. Fears of the Vladivostok fleet and of submarine mines drifted from their anchorage have kept many timid tourists from visiting Japan, and although some improvement has been noticeable of late, still the number appears to be a good deal below the average. Increased taxation also has tended so to raise prices all around that Japan is becoming too expensive a place for the ordinary tourist to visit."

A 90-ton steam shovel at the Hull mine in Minnesota loaded from a stockpile 138 thirty-ton cars, or a total of 4,140 tons.

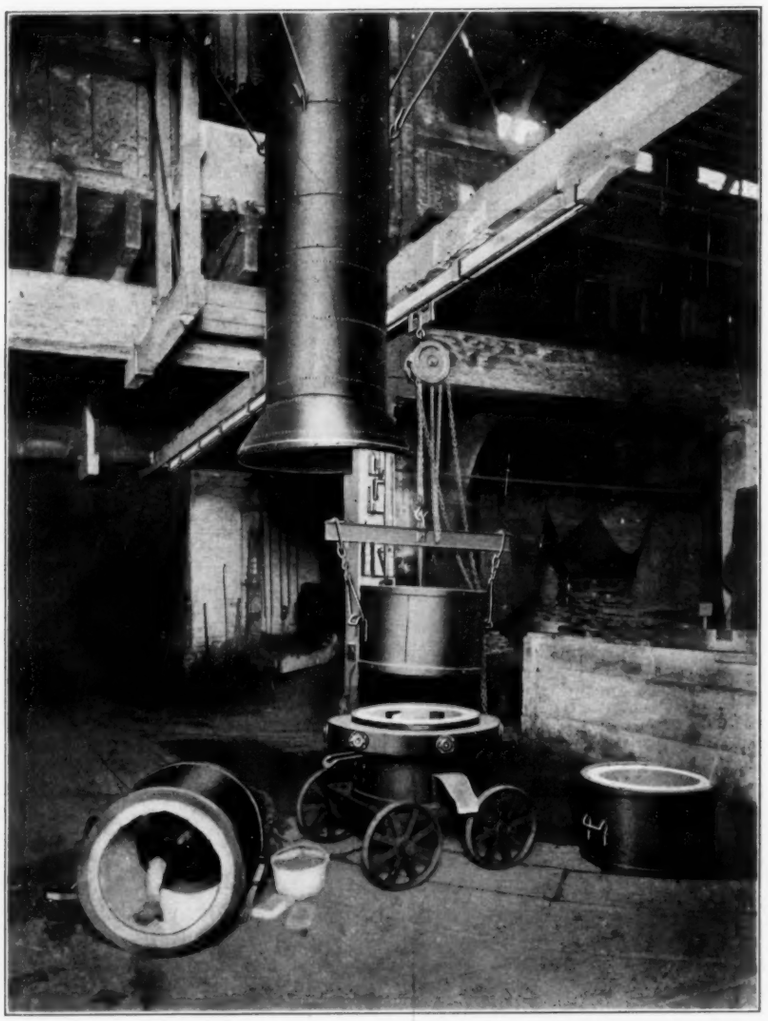


FIG. 2. A SECTIONAL CUPOLA.

Factors of "Pi."

BY WILLIAM COX.

Many attempts have been made to prove by different processes of reasoning that the ratio of the diameter to the circumference of a circle is 1 to 3.2, and not, as we know and accept it, 1 to 3.14159, but without apparent success. How much simpler this value would be if only it were correct, and how many of our calculations would be made easy! And yet the generally adopted value, 3.1416, should not be so much despised, as it is not so terribly unmanageable, but is divisible by more than sixty different numbers without leaving a remainder.

The number 3.1416 is the product of $2 \times 3 \times 4 \times 7 \times 0.11 \times 0.17$, from which we obtain the various divisors of 3.1416 which leave no remainder, given in Table 1. The knowledge that these divisors exist may often simplify a calculation and enable a fraction, having 3.1416 for the divisor or for the dividend, to be quickly reduced to much simpler terms; thus, $\frac{3.1416}{231} = 0.0136$, where 231 is the number of cubic inches in a United States gallon, while $\frac{136}{3.1416}$ reduces at once by means of the table to $\frac{1}{0.0231}$.

It may also be noted that 3.1416, divided by 5,280 (the number of feet in a mile), gives 0.000595, without remainder.

3.1416 DIVIDED BY

2	=	1.5708	68	=	0.0462	561	= 0.0056
3	=	1.0472	77	=	.0408	616	= .0051
4	=	0.7854	84	=	.0374	714	= .0044
6	=	.5236	88	=	.0357	748	= .0042
7	=	.4488	102	=	.0308	924	= .0034
8	=	.3927	119	=	.0264	952	= .0033
11	=	.2856	132	=	.0238	1,122	= .0028
12	=	.2618	136	=	.0231	1,309	= .0024
14	=	.2244	154	=	.0204	1,428	= .0022
17	=	.1848	168	=	.0187	1,496	= .0021
21	=	.1496	187	=	.0168	1,848	= .0017
22	=	.1428	204	=	.0154	2,244	= .0014
24	=	.1309	231	=	.0136	2,618	= .0012
28	=	.1122	238	=	.0132	2,856	= .0011
33	=	.0952	264	=	.0119	3,927	= .0008
34	=	.0924	308	=	.0102	4,488	= .0007
42	=	.0748	357	=	.0088	5,236	= .0006
44	=	.0714	374	=	.0084	7,854	= .0004
51	=	.0616	408	=	.0077	10,472	= .0003
56	=	.0561	462	=	.0068	15,708	= .0002
66	=	.0476	476	=	.0066	5,280	= .000595

TABLE 1—FACTORS OF 3.1416.

Similiarly $\frac{\pi}{4}$ or 0.7854 (which, multiplied by the square of the diameter of a circle, gives its area) is the product of the factors $2 \times 3 \times 7 \times 0.11 \times 0.17$, and is divisible, without remainder, by thirty numbers, as shown in Table 2.

0.7854 DIVIDED BY

2	=	0.3927	34	=	0.0231	238	= 0.0033
3	=	.2618	42	=	.0187	357	= .0022
6	=	.1309	51	=	.0154	374	= .0021
7	=	.1122	66	=	.0119	462	= .0017
11	=	.0714	77	=	.0102	561	= .0014
14	=	.0561	102	=	.0077	714	= .0011
17	=	.0462	119	=	.0066	1,122	= .0007
21	=	.0374	154	=	.0051	1,309	= .0006
22	=	.0357	187	=	.0042	2,618	= .0003
33	=	.0238	231	=	.0034	3,927	= .0002

TABLE 2—FACTORS OF .7854.

In conclusion, it may be of interest to some to remember that the ratio 113:355 is more exact than the ratio 1:3.1416, and is of easy use with the slide rule, although I use its double, 226:710, because there are positive lines on the rule and slide for these figures, which can be set exactly opposite each other, thus eliminating all errors which might arise from guessing or estimating their position.

The value of 113:355 to seven places of decimals is 3.1415929, while the value of π is 3.1415928, equivalent to a difference of about 1 inch in 150 miles, which it seems to me will never be appreciated on this globe.

The number of passengers carried by the railroads of this country in the year ending June 30, 1904, was 715,419,682, an increase of 20,508,147. The passenger mileage, or the number of passengers carried one mile, was 21,923,213,536, having increased 1,007,449,655.

The number of tons of freight carried was 1,309,899,165, which exceeds the tonnage of the previous year by 5,504,842. The ton mileage, or the number of tons carried one mile, was 174,522,089,577.

Phenomena of Machine Operation.*

BY JOHN RICHARDS.

Among the many agencies and means that contribute to the evolution and better performance of machines and determine their endurance and economy of construction, there is one, sometimes ignored and in all cases underrated—the phenomena of their operation; that part which is not computable or learned by rules.

This factor, element or condition, whatever it may be called, however strongly it may assert itself in results, is not regularly recognized in the engineering literature of our day; and the object of the present short essay is to urge its claims and importance upon those who are called upon to deal with machine problems—a long-suffering class of people who need whatever aid can come from this or other source.

In static structures, that do not involve machine motion, or that branch of constructive work we commonly call civil engineering, there is a close relation with science; means and agents are becoming uniform and can be computed and results predicted with much certainty. Strains can be defined; the properties of material are ascertainable; and extraneous forces, such as stress of the elements, the stability, oxidation and decay of material, and even its deterioration by fatigue, are becoming known and computable.

In machine operation, however, the path is by no means so clear and perhaps never can be. Nevertheless, progress is being made, and some of the general phenomena of operation are becoming susceptible of computation and scientific treatment; but, as I believe, to a much less extent than is generally assumed and believed.

To present the subject in a practical way, I have chosen the only means that seem available when considering things not computable, that is by citation or observed facts, and I shall refer to some typical examples. First among these may be mentioned the evolution of apparatus to impel fluids, especially liquids, by centrifugal force.

This is seemingly one of the most simple of all means for creating pressure. A body of liquid, confined in a fixed circular chamber, or contained in a revoluble circular vessel, can be set in revolution without other resistance than friction, and this can be reduced to a very low degree in vessels that revolve with the liquid they contain, creating almost unlimited centrifugal tension; but the removal of the liquid from the vessel or chamber, or its discharge, and the translation of its rotary energy into pressure involve various mechanical impediments, so that the art has been in evolution for half a century past.

This process engaged the attention of the celebrated French engineer, Emil Bourdon, who constructed machines that worked up to high-water pressure—more than 1,000 pounds per inch, it is claimed. Some work in the same direction has been done within a few years past, here in California, both with liquids and with elastic fluids, but with what particular results I am not able to say. I mention the method as one phase in the evolution of centrifugal apparatus that may in future have some importance.

During the latter half of the past century, which covers practically the development of the common forms of centrifugal pumps, in which the fluid is set in revolution in a fixed chamber or casing, we have had a maze of computations by eminent scientific men bearing upon the construction and operation of such machines; but, so far as I am aware, no clear or correct explanation of the phenomena of their operation or of the varied conditions of their use.

Such computations as we have were naturally based upon certain assumed premises derived from obvious hydraulic laws, and, to some extent, from experiments; but these latter have not been of a kind to disclose what we call the principle or mode of action, including the whole passage of liquid through the machines.

The main resistances that qualify effect were sought out and shortened into formulas which are, in the main, correct. Arrangements and proportions were based upon such formulated data, and fifty years have since passed, with progress, it must be admitted, but, as I maintain, without providing a clear concept and treatment of what has been called the phenomena of operation. Strange to say, the impediment to such concept and treatment was confined almost wholly to the simple matter of returning the water, after its rotation, to a state of rest or service-flow, without a loss of the kinetic energy required to set the water in revolution.

That there was a good deal of mystery in this matter is sufficiently proved by the fact that a good share of the literature relating to such pumps has been devoted to the shape of the impelling vanes, a thing which modern practice shows to be of no importance and almost a negligible matter in constructive design. The function of such vanes is to set the water in revolution, and is but little more, except as to a slight modification of frictional resistance. The body of confined water in revolution is the thing to be considered. The vanes, except as to the function named, are merely a portion of the mass in revolution, moving at a rate, relatively, which renders their shape and curves a matter of little importance.

It was or should have been obvious, from the beginning, that the only considerable loss of energy took place in the zone between the impellers and the collecting or discharge chambers; but it required, as before stated, about half a century to complete this discovery, or, rather, to devise apparatus that would adapt itself to this fact, and a manner of operating accommodated thereto.

The most successful attempt at preserving or utilizing the kinetic energy of the water's revolution was made a few years ago by Messrs. Sulzer Bros., of Switzerland, who introduced separating vanes in the dispersion zone of centrifugal pumps, to divide the water into distinct divergent streams and to preserve it from agitation until its energy was translated into pressure.

To accomplish this, the dispersion passages had to begin with an area that would collectively vent a particular volume of water at the velocity required to balance the head or resistance. Such construction, when the castings and internal surfaces were true and tolerably smooth, increased the efficiency of such pumps, for the higher pressures, about 10 per cent. or more, compared to those without a dispersion zone or when the water is discharged from the impeller directly into a collecting chamber; but, at the same time, it set up impediments and limitations of a very formidable kind.

The castings are difficult to make; the acute points of the dispersion vanes wear away; but, most of all, the pumps have to be driven at an invariable speed and to deliver a specific volume of water in order to gain this higher efficiency. There is also a very considerable increase in dimensions and in cost of construction, and it remains to be seen whether a satisfactory efficiency cannot be attained without encountering these impediments.

We are in no position to know the value of divided water passages in the dispersion zones of such pumps until the cause of losses there is understood. A mass of water, moving at a high velocity, is easily disturbed and broken up into devious currents and courses, especially when the water is moving in a circular path, and it is easy to conceive that rough-cast surfaces and imperfect shape of the discharge-way produced the principal loss in an open discharge zone. Computation furnishes no clue to this matter.

The future will, no doubt, determine this, not suddenly, or as a discovery, perhaps, but by a careful study of the construction and adaptation of such pumps to the theoretical and also the practical conditions of design.

To make a theoretical centrifugal pump from computed data is quite a simple matter. A diagram, to cover or include the water passages through a pump, with a cross-section as the volume and inversely as the velocity, the length of the diagram representing the acceleration and retardation of flow, will disclose a design theoretically correct, and would only require that such a diagram be surrounded by a confining chamber of sufficient strength.

In practice, however, such a scheme would fail. Every pump would become a

*A paper read before the Technical Society of the Pacific Coast.

special machine for a specific volume and head; contraction of the water passages would prevent the passage of solids, except those of small size; the disturbance by the roughness of interior surfaces and divergence of course would interrupt and modify the velocity of flow; the machines could not be cheaply produced by the implements of organized manufacture; they would fail to meet the diversities of use, and the cost would far exceed the commercial standards that now prevail.

The conditions of practical use demand that pumps be made, within certain limits, for both high and low pressures, or with a considerable range of adaptation to different pressures; they have to be employed for various liquids, pure and impure, viscous and corrosive and to pass solids of various kinds, including sand and gravel. They must endure abrasive scour in their water passages and exposure of their journal bearings, and they must be provided against unequal pressure or lateral thrust on the impellers. Interior surfaces, where the velocity is great, should be in true contour and finished smooth, with other features which could be named and which lie wholly outside of what we may call a compound or theoretical construction.

These are the circumstances such as cause long periods of evolution, require extensive observance of the phenomena and conditions of operation, and have to be learned tentatively, by inference, observation and experiment.

I have reverted at some length to centrifugal pumping, but the like circumstances apply to nearly all fluid machines which, as a class, have received the highest possible scientific treatment.

For another example, turbine water wheels were made the subject of research by eminent French engineers, who, previous to the middle of the past century, commissioned and aided by their government, laid down laws and scientific rules to govern the construction of these important machines. It was, no doubt, the most thorough and successful attempt of the kind ever made, and produced the three types of turbine water wheels known as the Fourneyron or outward flow, the Jonval or parallel flow, and the partial turbines or impulse wheels of Girard.

About 1850, the subject was taken up in this country by two American engineers, Boyden and Francis, who constructed, at Lowell, Mass., what have remained, to the present time, the finest examples of Fourneyron turbines on this continent. Mr. Emil Geyelin, a French engineer, came a little later to Philadelphia and introduced the Jonval type of turbines. The Girard type or partial turbines has not been successfully exploited in this country, if we except the wheels lately erected at Niagara Falls.

Here was a complete mathematical development of water turbines, carried out to a skilled construction and to operate at the greatest efficiency. The subject of the water turbine seemed ended, and the writer, who was then engaged in that bygone occupation called "millwrighting," assumed and claimed that this art, at least, had culminated. And so it had, in so far as efficiency was concerned; but there was another phase to be dealt with in the operating conditions.

The French turbines were refined machines, exact, expensive, and adapted for pure water. Our streams are mostly in flat lands, fluctuating and turbid. Gravel, driftwood and other kinds of débris would not pass through the fine issues of the new turbines, and American mechanics began, in an experimental way, "whittling" out new models. In the French wheels the running, finished and expensive elements were outside and occupied the extreme diameter, while the rough and inexpensive fixed elements were placed internally and were of relatively small diameter. This resulted in expensive construction and a slow rate of revolution, requiring strong and expensive gearing for transmission.

So accustomed were engineers to associate centrifugal effect with turbines, that radial or outward flow seemed an essential condition, when, in fact, it had little or nothing to do with the case. This was found out by experiment and should have been evident from the beginning.

The American mechanics, after many years of "whittling" out models, succeeded in turning the wheels "inside out," or inverted them, so to speak, making the internal or smaller elements the running part, so that the water flowed inward toward the center, then changed its course 90 degrees downward in helical passages for escape. This was done entirely without scientific aid, in some cases even controverting scientific rules, and the result is the centripetal or inward flow turbine, the standard water wheel of this country, of which a single firm has made more than 10,000, and the wheels have even found their way back to France. Their efficiency is fully equal to, or even greater than, that of the older types, and the cost of the wheels is about one-half as great. This evolution has required about sixty years, and present practice rests mainly upon observed phenomena and upon the operating conditions rather than upon computed data. There was not even a draftsman in the works where were made the wheels that gained the highest award at the careful trials conducted at the Centennial Exposition, in 1876.

This whittling method, as it has been called, was certainly slow and unnecessary, but was followed by shrewd mechanics in a roundabout way at great and unnecessary expense in money and time. At least, this is the way the matter seems to us now, but we are undoubtedly proceeding in like manner in the case of many other less intricate machines, as posterity may point out.

In respect to the Girard type or impulse wheels, Weisbach and others had contemporaneously, or earlier, investigated the laws that govern the effect of impinging fluids, and such laws were carefully observed in the development of partial turbines in Europe, where such wheels are now the standard type for the open or impulse class; but on this coast, mainly by reason of very high heads or pressures and the accurate work required in wheels of this kind, there commenced, about twenty-five years ago, a modification suggested by the peculiar operating conditions, producing a new class, known as the "tangential" type.

The development of this was, to a great extent, another case of "whittling" out models, and the old experience had to be gone over again. Notwithstanding that a good deal of scientific data relating to such water wheels was furnished at the beginning by Professor F. G. Hesse, of the University of California, the phenomena of operation continued to be observed, and from various clues modifications were made, down to 1900, when it was discovered that the double buckets could be passed into and out of the stream by once dividing it. Other final features in the design of such wheels were noted also. They have since taken on the dress and finish of proper design and workmanship.

In the case of elastic fluids, impulse motors or steam turbines have been more than a century in evolution, notwithstanding that more than 400 separate patents have been granted in Great Britain alone for inventions pertaining to these machines, some of them a century ago and many of them fifty years ago. Mr. Parsons, an eminent English engineer, who has been prominent in this work during later years, is no doubt one of the greatest living adepts in the science of thermodynamics, and, as is claimed, he has forecast with much accuracy the development of his turbine schemes as they progressed from 48 down to 11 pounds of steam for each horse-power hour, but it is also claimed that he has expended half a million dollars in experiments. He has probably expended more than this.

If inquiry were made, Mr. Parsons would probably admit that not one-fourth of his data came from computed sources, and that the observed phenomena of operation and adaptation have comprised the other three-fourths.

I might mention Lenoir's gas engine, the first of the internal combustion class. I examined an old engine in 1870, the first successful one, and I strongly suspect that, aside from the operating phenomena, this machine has furnished suggestions for nearly all improvements since, except perhaps the graduated combustion in the Drayton and Diesel types, yet in evolution, owing to impediments that arise in construction.

A wider and more important example of evolution in operating phenomena is furnished by piston steam engines. I do

not mean the thermodynamic development of these, which is the greater part, furnished mainly by scientific deduction and experiment, but to the mechanical evolution of their operating parts, which had to keep pace with the thermal problems.

The "elimination of the speed factor," as our worthy president calls it, not only in the rotative, but also in the reciprocating parts of such engines, is a wonderful example of experimental development.

Down to twenty-five years ago it was a common object, in steam-engine design, to reduce surface and velocity in bearings, partly to avoid friction, and partly because reduction of weight and space were also incentives, but the operating phenomena of machine bearings was a mystery in so far as any scientific rules were available.

Forty years after the publication of General Morin's experiments, which established a generally accepted law of friction, we find that alignment and pressure were considered subordinate when compared with surface in bearings.

Alinement, or the fit of bearing surfaces, especially in the case of cranks, is yet a mystery, if considered in a practical way. The most careful computations, respecting the flexure of shafts, frames, crank disks and pins, fail to disclose the operating phenomena. One has only to observe the center of an overhung crank or disk, even of the strongest proportions, to see that it describes a visible ellipse when under heavy strain and for reasons not explainable by computation. French makers of steam engines so dread this phenomena that, I believe, none of them employ overhung cranks.

Similar obscure operating conditions exist in various other parts of steam engines, and proportions are, beyond question, based more upon observed operating phenomena than upon computed dimensions.

Bearings that operate under steam—slide valves, for example—were scraped to a perfect fit; cylinders were bored out with a smooth, glistening surface, under a belief that such fitting was theoretically correct; but, by accident mainly, it was found that the bearing surfaces performed much better when they were not smooth and in perfect contact. A film of interposed water or oil produced the uniform fit.

In crushing hard material, such as quartz, with metallic surfaces, it was naturally inferred that the metal opposed to the stone should be as hard as possible, but, for reasons not easy to explain, soft metal endures longest. Cornish rollers are now covered with rings or tires of soft, fibrous iron. The sand blast discloses a like phenomena. It is easier to bore a hole through a file with the sand jet than through a thin sheet of copper. An emery wheel will rapidly cut away tempered steel, but not soft iron. It is a problem of friability, no doubt, but is not fully explained.

The whole field of mechanics is full of unexplained phenomena and mysteries, such as the temper of steel, the fatigue of metals, their crystallization under rythmic concussion, the inherent strains in molded steel, the surge and reaction of moving liquids under high pressure.

The purpose of this short paper is to call attention to the fact that the conditions of actual practice are often best met not by machines figured out and determined on a drafting board from scientific data, and thus produced with exactness and success, but rather by such as have come to us through the long line of evolution and have been developed mainly by other means than computation.

Much that is written is apt to lead to the conclusion that scientific calculation alone suffices, in machine design, without practical observation of the operating phenomena and the conditions of use. Academic institutions should, at least, temper their theoretical instructions with the required warning that the phenomena of the operation of machines must be a principal factor in their successful evolution.

The Index.

The index for the first half of the present volume is inclosed to all mail subscribers with this issue. Those who obtain the paper through the news agencies can obtain copies by sending request to this office.

Personal.

W. L. Shellenbach, 21 Wiggins Block, Cincinnati, O., is at present engaged in laying out the new machine shops of the Black-Clawson Company, Hamilton, O., and is arranging all of their larger machine tools with individual motor drives.

C. A. V. Carlsson has resigned his position with McIntosh & Seymour, Auburn, N. Y., to accept a position as chief draftsman with the Chicago Pneumatic Tool Company at its compressor plant, Franklin, Pa. G. B. Cowan, who has held the position for several years, goes to Canada to assume management of the Gananoque Bolt Company, Gananoque, Ontario, of which he is also director.

Halbert P. Gillette, M. Am. Soc. C. E., M. Am. Inst. M. E., and formerly associate editor of *Engineering News*, with George H. Gibson, A. M. Am. Inst. E. E., J. M. Am. Soc. M. E., formerly manager of publicity for the International Steam Pump Company, manager of the advertising department of the B. F. Sturtevant Company, and editor of the Westinghouse Companies' Publishing Department, have formed a partnership and opened an office in the Park Row Building, New York city, where they will do expert advertising work, calling themselves "Advertising Engineers."

Joseph A. Rothwell has been appointed superintendent of the Pioneer Iron Works, Brooklyn, N. Y. Mr. Rothwell has been connected with these works for seventeen years, entering them as a toolmaker, from which position he has, by his merits and ability, risen to his present position. In the positions of responsibility he has previously occupied in the works, his influence seems to have been for the good of both the men and the proprietors, the conditions of employment having been improved, while at the same time the best interests of the establishment have been thoroughly looked after. Mr. Rothwell has invented a number of devices of great use in facilitating the work, one of his ideas having been illustrated in our columns at page 161, Part I, of the present volume, a device for cutting internal and external spirals on the planer.

Obituary.

Walter H. Whitten, a pioneer in the designing and manufacture of turbine water wheels, died, August 23, at his home in Holyoke, Mass., 78 years old. He was president of the Holyoke Machine Company.

George C. Rumbold, who superintended the building of the *Great Eastern*, died at his home in East Orange August 21, eighty years old. He was born in London and superintended the building of many vessels for the British Navy.

Business Items.

The firm of Edwin H. Jonson, of 79 East One Hundred and Thirtieth street, New York, has been succeeded by Julius Jonson's Sons.

The Morse Chain Company, located at Trumansburg, N. Y., is now building at Ithaca, N. Y., a plant of about five times the present capacity. The company was incorporated in 1898, no change having been made either in the name or personnel since starting, F. L. Morse being the treasurer and general manager. The plant was originally started for the manufacture of bicycle chains, but in 1901 the company brought out the present high-speed silent-running chain, and since that time has had a rapidly growing business. In the line of power transmission the Morse Company has in service chains transmitting over 75,000 horse-power, and is furnishing drives up to 500 horse-power for a single transmission.

Manufacturers.

The Standard Machinery Company, Mystic, Conn., will erect a new foundry.

The Mianus (Conn.) Motor Works are contemplating building new factories.

Christian J. Dressler will erect a $15,000 factory on Holt street, Buffalo, N. Y.

The Diamond Iron Works, Minneapolis, Minn., will erect a $40,000 machine shop.

The Great Northern Railroad will invest $250,000 in new shops at Sioux City, S. D.

The Rockford (Ill.) Manufacturing Company will double the capacity of its foundry.

L. Harbach & Son will erect a large furniture factory on Fifth street, Des Moines, Iowa.

The Curtis Saw Company, St. Louis, Mo., is building a large addition to its present plant.

The Ohio Iron & Steel Company, Lowellville, Ohio, is erecting a large casting house of steel.

Architect Leonard Metcalf, 14 Beacon street, Boston, Mass., is drawing plans for an electric power station at Oakland, Me., for Messalonskee Electric Company. The work includes canal, 1,900 feet long; tail-race, 400 feet long; boiler-room, 45x45; engine-room, 50x75, and dam of earth and concrete.

The American Graphophone Company, of Bridgeport, Conn., has nearly completed plans for an addition to its power plant. A brick building, 30x38 feet, will be erected, and a 600 horse-power Allis-Chalmers engine will be installed. The engine will be connected with the Bullock generator, furnishing extra power to the plant, several additions to which have recently been completed.

A new power-house is in process of construction at Waltham, Mass. The building will be of concrete and steel construction, 153 feet in length, 100 feet wide and 35 feet high, with a boiler-room at the rear at a lower level. When the building is completed, three generator engines, now being built, will be installed; power will be supplied for electric lighting and for the street-car service.

Plans for an addition to the machine shop of the mechanical engineering department of Stanford University, California, have been drawn up, and work will be commenced in the near future. The building is to be one story, 140x60 feet. The material used will be buff sandstone, and the architecture will be similar to that of the other buildings of the university. The roof will be tiled, after the old Spanish style.

Proposals for precision lathe, machine tools, stocks and dies, gasolene engine and accessories, gasolene reservoir, circular saws, plate glass, iron packing spools, door knobs, roofing paint, etc. Office Isthmian Canal Commission, Washington, D. C., August 14, 1905. Sealed proposals, in triplicate, will be received at the Office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until 10:30 A. M., September 13, 1905, at which time they will be opened in public, for furnishing the above mentioned articles. Blanks and full information may be obtained from the offices of the Assistant Purchasing Agents, 24 State street, New York city; Custom House, New Orleans, La.; 36 New Montgomery street, San Francisco, Cal., and 410 Chamber of Commerce Building, Tacoma, Wash., also from Chief Quartermaster, Department of the Lakes, Chicago, and the Commercial Club, Mobile, Ala.—D. W. Ross, General Purchasing Officer.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

1 design factories and special machines. James F. Hobart, 66 70th st., Brooklyn, N. Y.

Wanted—Information concerning manufacturers of vacuum pans for evaporation of liquids. Sligo Furnace Co., Sligo, Dent Co., Mo.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Manufacturers' Agents.—We are prepared and desire to represent manufacturers of devices new in this territory. G. S. Carter Machinery Co., 225 North First st., Minneapolis, Minn.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Correspondence solicited. Send for references. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

For Sale.

For Sale—Small, well-equipped machine shop, near New York; cheap power. Box 513, AMERICAN MACHINIST.

One double-spindle McCabe lathe; will swing 48x26 in. on centers; lathe in perfect condition; price reasonable. Address Box 526, AMERICAN MACHINIST.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

The complete course in civil engineering, including about 12 bound volumes, as given by the International Correspondence Schools of Scranton, Pa. "Education," care AM. MACH.

For Sale—At a bargain, drawings, patterns and special tools for line machine tools; also large quantity finished and partly finished parts of machines. Address "Receiver," care AMERICAN MACHINIST.

For Sale—One-fourth interest in a gray-iron foundry and machine works doing good business, to a molder or foundry foreman, who will take charge of the foundry; excellent opportunity to start in business; about $2,000 required. H. H. Mason, Mt. Carmel, Ill.

For Sale—An up-to-date manufacturing shop, located in Manhattan, New York city, suitable for inventor, general machine, experimental work or manufacturing; first-class machinery; electric power; large assortment fine tools; foreign and domestic trade; patents, stock, good will, or plant alone; reasonable. Address Box 442, AMER. MACHINIST.

Business Opportunities.

Machinists who can take financial interest in shop write to Box 446, AMER. MACH.

Opening for Manufacturer.—The proprietor of a long-established foundry and machine shop in a small Ontario town invites correspondence from any reliable American manufacturer in the machinery line wishing to establish a plant in Canada. The plant is well equipped with modern tools, and the lines now being manufactured are sawmill machinery and turbine water-wheels. In these lines the business has a splendid connection throughout the Dominion, and this could be retained. Highest references given and required. All correspondence confidential. Address, in first instance, Box 522, AMERICAN MACHINIST.

Machine Shop for Sale.—Here is a great opportunity for someone who wants a business of his own. This is a modern plant, located in central New York. Main building, 100x60 ft., two stories, equipped with about 60 high-grade machine tools, including lathes, milling machines, shapers, drills, etc. Plant is adapted for automobile or any high-grade work, and is now running. This plant and business cost more than $50,000, and we can sell it for less than $15,000, if taken promptly. This price includes patents, jigs and tools for making a very profitable specialty. To the right parties we can make very favorable terms. Wm. A. Reade & Co., 402 Chamber of Commerce, Cleveland, Ohio.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS.

Mechanical draftsman desires position with small, progressive firm within 30 miles of Springfield; could give employer two machine tools to manufacture, if desired; 5 years' experience; have 3 machines on royalty now; American; married; age 30. Address Box 531, AMERICAN MACHINIST.

MICHIGAN.

Draftsman, with ability to design, for work on jigs and tools for manufacturing on the interchangeable plan; give full particulars, including experience, wages expected and date when convenient to begin work. Cadillac Automobile Co., Detroit, Mich.,

NEW JERSEY.

All-around mechanic, draftsman, technical graduate, age 28, at present employed as machinist in the line of building watch machinery; experience, 6 years' drafting room, in general machinery, some electrical instruments and apparatus; would like to change for position steady at drafting or in shop, or work at both occasionally. Box 532, AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman wishes position. Address Box 505, AMERICAN MACHINIST.

Draftsman, mechanical and structural, wants position. Box 533, AMER. MACH.

Mechanical draftsman, experienced on automobiles and automatic machinery, wants position. Box 524, AMERICAN MACHINIST.

Position as foreman and designer, by a toolmaker; jigs, gages, compound dies, experimental, etc.; 20 years' experience; good references; fine work. Address Box 529, AMERICAN MACHINIST.

Mechanical engineer, 34, practical toolmaker, with 9 years' experience as chief draftsman and assistant superintendent of large works, wants superintendency smaller plant. Box 411, AMERICAN MACHINIST.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

Mechanical engineer and expert designer, with long and varied experience, Corliss engines, power transmission, gas engines, is open for engagement; competent to take charge, and accustomed to the control of men. Box 485, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced draftsman and patternmaker, young man, wants position in Southern State. Box 523, AMERICAN MACHINIST.

Mechanical engineer, general work, wants position as chief draftsman or assistant superintendent. Box 495, AMERICAN MACHINIST.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 507, AMERICAN MACHINIST.

First-class mechanic, 37 years of age, with technical training obtained in correspondence school and 8 months' experience in drawing room, has good practical ideas and not afraid to work, and able to handle men, would like position of some responsibility; experienced mostly on engine and sugar machinery. Address A. E. G., care AMERICAN MACHINIST.

RHODE ISLAND.

Position as foreman or master mechanic; best reference. Address Box 530, AM. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Wanted—An experienced, energetic and competent factory superintendent, trained to fine work, who will become financially interested in the company; this is an unusual opportunity, as the company is young, thoroughly equipped, and has an assured future. America Co., Rockford, Ill.

Wanted—Machine shop foreman; good, live foreman to take charge of small tools and fitting floor in machine shop doing heavy and medium work, both contract and jobbing; good opening for hustler; give full particulars as to age, experience, etc. Box 514, AMERICAN MACHINIST.

Wanted—Expert drop forge die and tool designer on medium work, by large manufacturing concern; must be thoroughly posted on modern shop methods, with ability to handle men; in answering, state full particulars; no applicant will be considered whose record does not prove him to be of the highest grade. Box 463, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

MARYLAND.

Machine tool traveling salesman of experience wanted; must be well posted on metal planing and drilling machinery; salary and commission given. Address "Planer," care AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Operator for Cleveland automatic

screw machines. Address Boston Gear Works, Boston, Mass.

Wanted—Assistant superintendent and inspector, experienced in gear cutting job shop. Address, with full particulars, Boston Gear Works, Boston, Mass.

Wanted—First-class machinists for Jones & Lamson turrets, planers, drills, vise work, floor work; steady work; good wages. Apply to Campbell Printing Press & Mfg. Co., Taunton, Mass.

NEW JERSEY.

Wanted—A1 electrical draftsman and machine designer. Address Box 527, AM. M.

Good mechanical draftsman wanted at once; state experience and salary expected. Box 517, AMERICAN MACHINIST.

Wanted—First-class draftsman and designer, capable of taking charge of 6 others; give experience, reference, salary, age. Address Box 515, AMERICAN MACHINIST.

Wanted—Machinists familiar with vise work and erecting stationary engines and air compressors; give age, experience and previous employment. Address Box 458, AM. M.

Wanted—A competent mechanical draftsman for work on condensers, pumps, etc.; location near New York. Address, stating age, experience, etc., Box 528, AMER. MACH.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Two good mechanical draftsmen; those having experience on printing machinery preferred; state experience, age, pay wanted and references from two former employers. Address Box 516, AMER. MACH.

NEW YORK.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Bookkeeper wanted; experience in iron, steel or machinery lines, with knowledge of stenography, preferred. Address, stating age, experience and salary expected, "Progressive," Box 519, AMERICAN MACHINIST.

Wanted—First-class detail draftsman, capable of making neat, accurate working drawings from sketches; men familiar with small electrical apparatus preferred. Address General Railway Signal Co., Buffalo, N. Y.

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OHIO.

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VIRGINIA.

Wanted—Mechanical draftsman; preferably one with experience in making elevator plans and layouts. The J. B. Westbrook Foundry & Machine Co., Danville, Va.

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Wanted—A practical machinist to manufacture a steam specialty of high merit. Address P. O. Box 52, St. Paul, Minn.

Wanted—Six good gas engine engineers, familiar with operating large engine plants; good salary to right men; give experience and reference. Box 426, AMERICAN MACHINIST.

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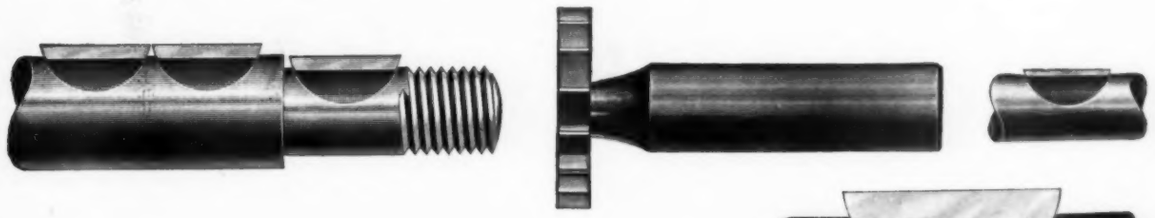

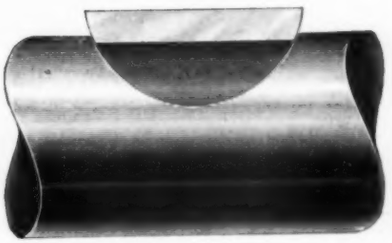

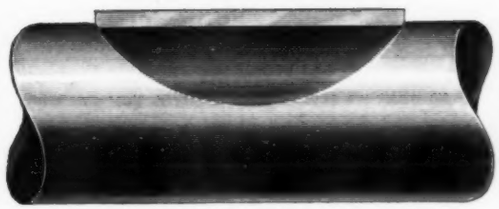

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Controllers and Starters, Electric Motor
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General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Coburn Trolley Track Co., Holyoke, Mass.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York,
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Bolt
Brown Co., H. B., Easthampton, Conn.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.

Cutting-off Tools—*Continued*
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Morton Machine Tool Wks., Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., The, Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
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Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
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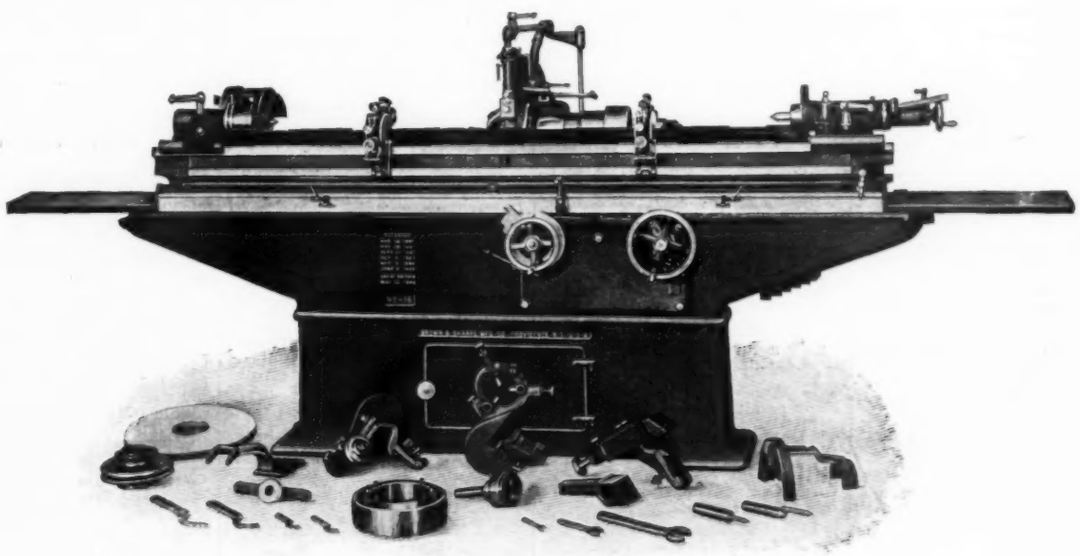
That are adapted to meet the most exacting requirements of Commercial Grinding.



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Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Street Bros. Machine Co., Chattanooga, Tenn.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

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McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engineers, Mechanical and Consulting
Thomson, Hugh L., Waterbury, Conn.

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Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Abenaque Mach. Wks., Westminster Station, Vt.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Binner-Wells Co., Chicago, Ill.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.,
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

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Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

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Rotary File & Mach. Co., Brooklyn, N. Y.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

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Houghton & Co., E. F., Philadelphia, Pa.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

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Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Sevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park.

Friction Boards
Ingalls & Co., Castleton, N. Y.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm, Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.

Gears, Worm—*Continued*
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Sturtevant Co., B. F., Boston, Mass.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grates
New England Roller Grate Co., Springfield, Mass.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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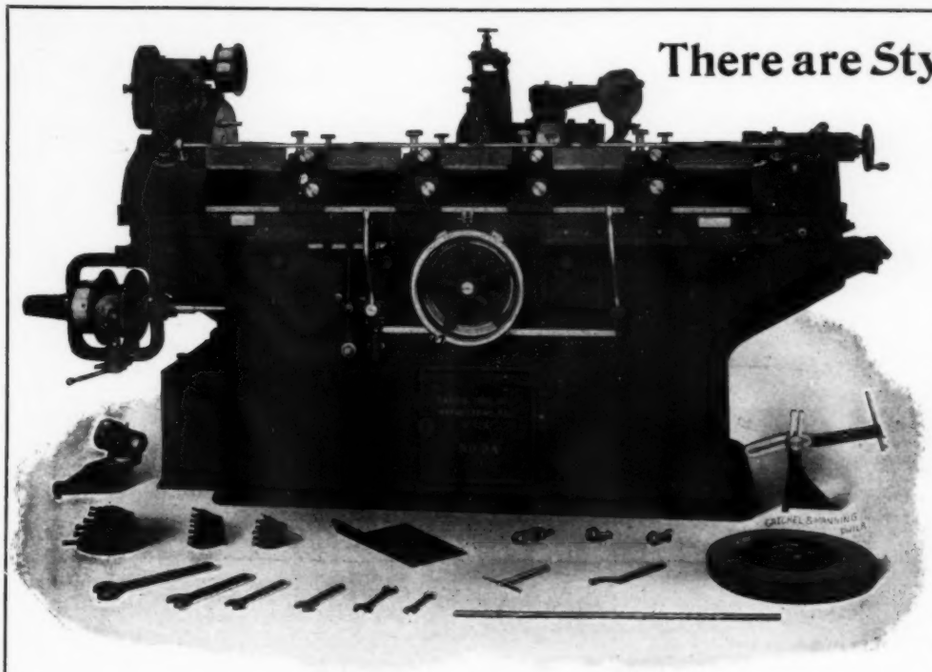
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.



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12″ Swing, 66″ Between Centers

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A grinding machine like this Landis No. 24 will do your grinding in just about one-third of the time required by old methods. You can get results within .0001″ of absolute accuracy. If you have been doing grinding in a slip-shod, imperfect way, let us make you acquainted with Landis Grinding Machines and the style that will best meet your requirements.

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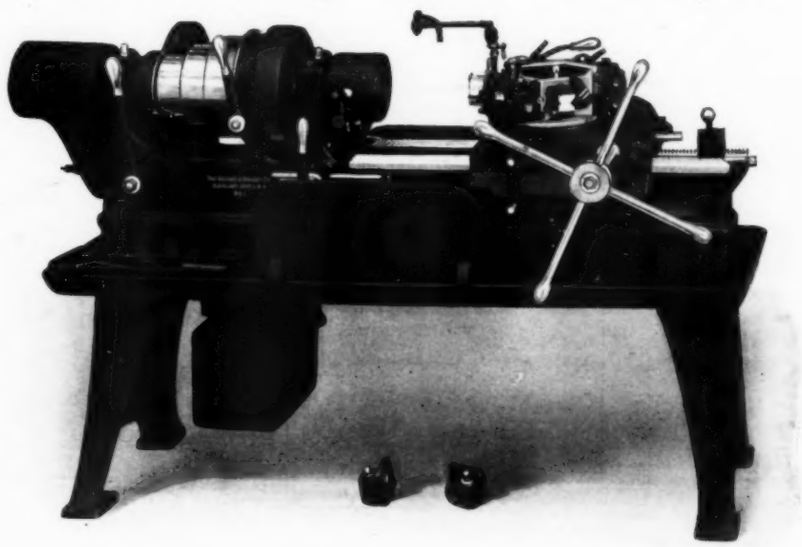

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Grinding and Polishing Machines—*Continued*

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Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
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Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels

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Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Machine Co., Athol, Mass.
Cleveland Stone Co., Cleve., O.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames

Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power

Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Electric

Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Power

Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Pneumatic

Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Steam

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Screw Plate

Standard Welding Co., Cleve., O.

Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
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Hyatt Roller Bearing Co., Harrison, N. J.
Pryibil, P., New York.
Wood's Sons, T. B., Chambersburg, Pa.

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Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric

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Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

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General Pneumatic Tool Co., Mon-
International Steam Pump Co., New York.
tour Falls, N. Y.
Rand Drill Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.

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Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

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Sellers & Co., Wm., Phila., Pa.

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Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

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Jacks, Hydraulic

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters

Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill-Standard Mfg. Co., Anderson, Ind.
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Niles-Bement-Pond Co., New York.
Street Bros. Machine Co., Chattanooga, Tenn.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

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Hammacher, Schlemmer & Co., New York.

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Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

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American Tool & Mach. Co., Boston, Mass.
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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
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Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
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Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.

Lathes—*Continued*

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Lodge & Shipley Mach. Tool Co., Cincinnati, O.
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Motch & Merryweather Machinery Co., Cleveland, O.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
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Schumacher & Boye, Cincinnati, Ohio.
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Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Silk Mach. Tool Co., P. P., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench

American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Niles-Bement-Pond Co., New York.

Lathes, Brass

Pratt & Whitney Co., Hartford, Conn.
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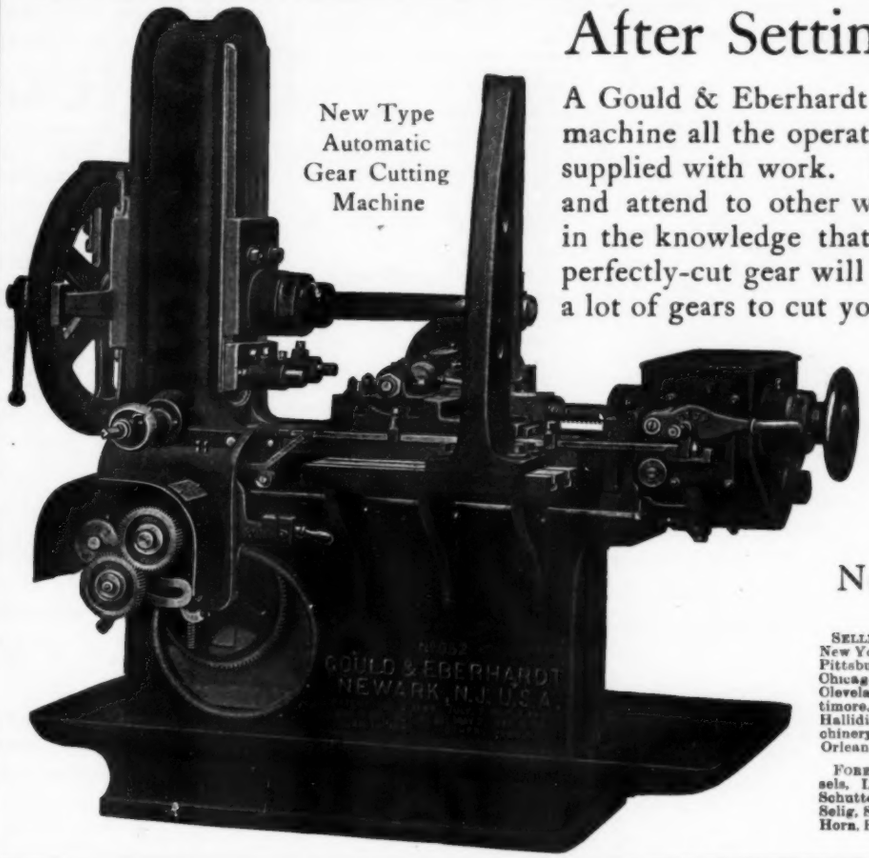

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Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Cincinnati Milling Mach. Co., Cincinnati, O.
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Garvin Mach. Co., New York.
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Hill, Clarke & Co., Boston, Mass.
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Silk Mach. Tool Co., P. P., Cincinnati, O.
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American Watch Tool Co., Waltham, Mass.
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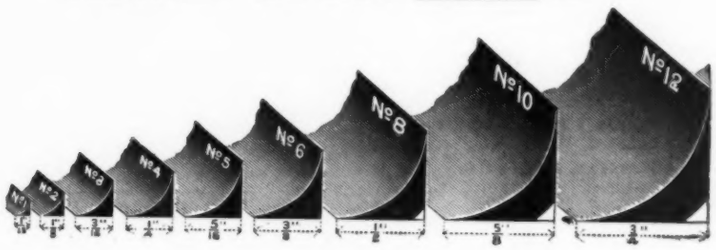

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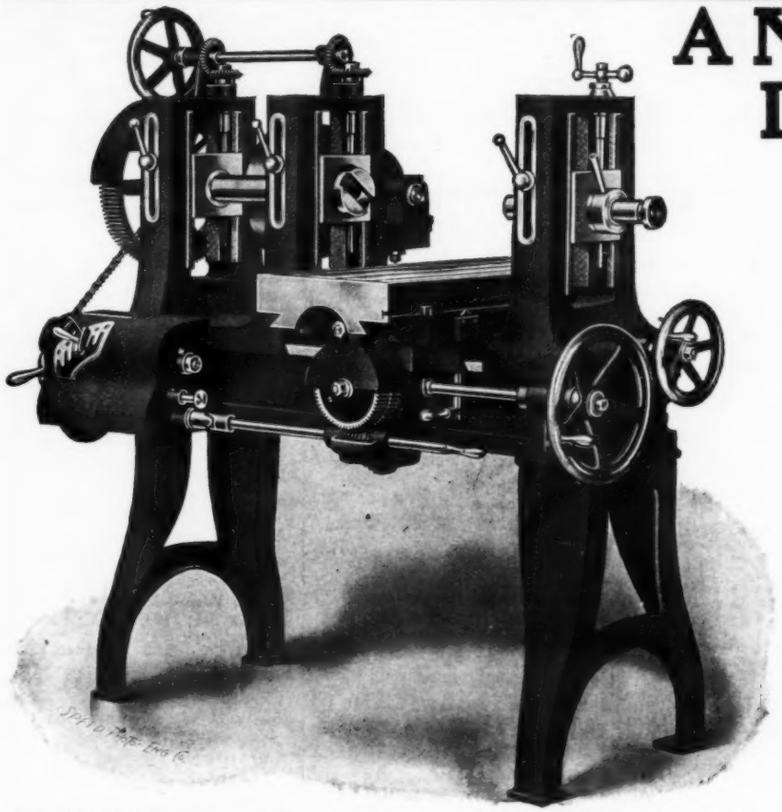

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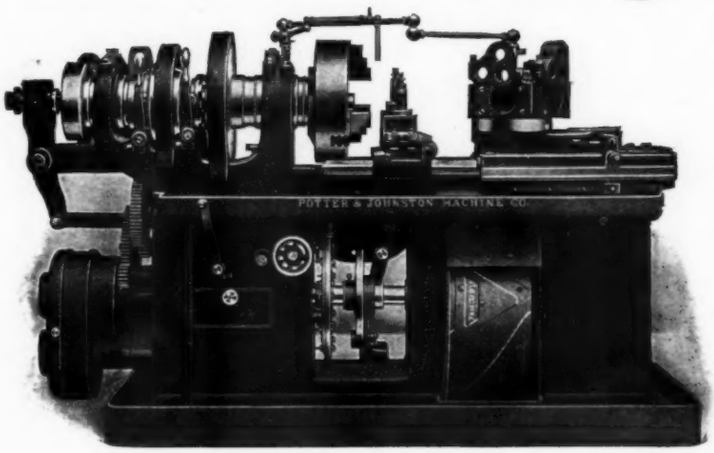

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Pryibil, P., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Hawkeye Wrench Co., Marshalltown, Iowa.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.
Hawkeye Wrench Co., Marshalltown, Iowa.